APR 21 1922

ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

McGRAW-HILL CO. INC.

PRICE 15 CENTS

Engineering and Mining Journal-Press does not sell its front covers to advertisers. In uniting Engineering and Mining Journal with Mining and Scientific Press, however, the combined journal has respected existing advertising contracts. Some of these made with the Mining and Scientific Press were for its front covers. Through the courtesy of these advertisers such obligations have been released. The front cover this week has been released by the kindness of Joseph Dixon Crucible Company, whose advertisement will be found on page twenty.

The Marketing of Tungsten

By Charles Hardy

Mineral Sulphides as a Source of Electric Energy

By G. N. Libby

Copper Smelting by Central African Natives

By Sydney H. Ball

Asbestos Mining and Milling in Quebec—II

By Walter A. RuKeyser

Plant of Garfield Smelting Company, Garfield, Utah, looking east.

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

April 22, 1922

Big Elevators for Heavy Work
Two 54-inch by 24-inch Pan Conveyors, 70 ft. 0 in. and 85 ft. 0 in. centers respectively, installed at Pyramid Portland Cement Company, Des Moines, Iowa.
S-A MFG.CO. 5643
For the heavy work there must be machinery correctly designed and well built.
S-A Engineers are ready to offer advice on projects where heavy elevating and conveying equipment is required.
Have your name on the mailing list to receive the "Labor Saver," which contains timely articles on the modern developments in elevating and conveying machinery.
Stephens-Adamson Mfg. Co.
Aurora, Illinois
AURORA S-A MFG.CO ILLINOIS
S-A MFG. CO. 24
TYPICAL ASSEMBLY
S-A PAN CONVEYOR STYLE J

T. A. RICKARD
Contributing Editor

G. J. YOUNG, Western Editor
D. E. A. CHARLTON, Managing Editor
A. H. HUBBELL, News Editor
E. H. ROBIE, Metallurgical Editor

ENGINEERING & MINING JOURNAL-PRESS

J. E. SPURR, Editor

F. E. WORMSER
W. N. P. REED
A. W. ALLEN
A. B. PARSONS
Assistant Editors
BENJAMIN MILLER
ROBERT M. HAIG
Special Consulting Editors

Volume 113 | New York, April 22, 1922 | *Number* 16

A Russian Opportunity

GOLDEN OPPORTUNITIES are scarce these days, so perhaps the one revealed to us by a caller recently may be interesting. Our caller said that ten thousand American engineers and workers would open up at once in Russia—in Siberia—the "greatest industrial region in the world." Volunteers are asked for, to take charge of a mighty territory with every conceivable industry already established, but badly neglected. If you are interested, we will gladly furnish the New York address where you can make application. You must pass a severe examination as to physical fitness; you must have $300, one-third each for transportation, food, and tools; and you must turn this money over to the organization committee. You must pledge yourself to submit to discipline, and in the last analysis to accept as final "the highest Soviet authority in Russia." You pledge yourself "to take into consideration the extreme nervousness of the hungry and exhausted Russian workers and peasants, and to try by all means to avoid friction, jealousy, and misunderstandings, and to attempt by all means to establish friendly and amicable relations." (We are quoting the promotion pamphlet, issued in February, 1922.) The applicant must pledge himself "to work at least two years in Soviet Russia and to pay his own traveling expenses thereto, for clothes for two years, $100 for food, and in addition $100 or more for necessary tools and machinery."

Why are the workers in Russia "hungry and exhausted"? Why are the factories closed and the machines idle, as the pamphlet explains, despite the glorious fact that the Russian Revolution "gave the land to the peasants and the factories to the working man"? The artless promotion literature explains all. "The industrial workmen started production under revolutionary control, and the demands of the revolution called them from the factories." . . . "Some went to the front in charge of the Red Army." . . . "Others became administrators of the government. Less conscious workers returned to the villages to till their acreage of free land. These three movements from the factories continued until at last the factory had to close down for want of skilled proletarian labor." Therefore, ten thousand Americans are wanted at once to reopen the factories.

What will they get? "The workers will receive from their production a satisfactory standard of living. . . . The remaining product (except the customary Soviet taxes) will be used to extend the industrial equipment of the enterprise."

Are you equipped for the enterprise? The organization must have "full-chested, open-air men; men who can do things, while they get their dinner from the river and snap it on the wing; men who can stand lonely nights on the edge of the earth and do it willingly, because of the big thing that stands as a beacon light before them."

"Why go at all?" you may ask. Even this may be found in the promotion pamphlet. Each member "undertakes to work at his or her highest capacity, in order to create the highest form of production, so that they will prove by deeds that the workers are more capable of operating industry than the capitalists."

We have had many illuminating close-ups of Russia, but these extracts from a Soviet pamphlet carry a peculiar conviction.

O foolish and dreamy-eyed children! Where is the merciful Providence that watches over children, drunkards, and fools? They die like sheep in a Wyoming blizzard, back on the Russian steppes, or huddled into the ruined houses of Petrograd and Moscow. The greatest tragedy of all national tragedies is being enacted day by day; yet the vague-eyed Marxian philosopher and foe of capital and profit, with a full New York capitalistic meal beneath his vest, is dreaming of recruiting ten thousand enthusiasts with two years' capital each, whose capital shall prove that capital is unnecessary and money undesirable. He came to us to ask to serve as our correspondent in Russia, for money, and was disappointed at the smallness of our rates of pay.

Proposed Congressional Action on Trade Associations

THE ENCOURAGEMENT and wise regulation of trade associations, and a stated modification of the so-called anti-trust laws, which we referred to editorially on April 1 as having been under investigation by the Department of Commerce under Mr. Hoover, has been further sought after through the legislative branch, in a resolution introduced on April 3 in the Senate by Senator Edge, of New Jersey, and in the House by Representative McArthur, of Oregon. The resolution provides for the appointment of a committee of three Senators and three Representatives to make a study of the subject and recommend legislation "to define the rights and limitations of co-operative organizations, as distinguished from illicit combinations in restraint of trade."

In commenting on his resolution, Senator Edge said: "These are days of necessary business organization in order to cut overhead and assist in minimizing costs of production and distribution. To accomplish this, co-operation, of course, is essential and necessary. The distinction between monopoly and illegal restraint of trade and co-operation, which should lower costs to the consuming public and thus encourage activity in markets, should be clearly defined, and, in my judgment, can be. Certainly, the present situation is intolerable and must be remedied."

We have several times editorially cited the Government action in aid of the farmers as an example of what should be extended to the miners.

Senator Edge also called attention to the analogy between the necessity for co-operative action by the

farmer, already granted by Congress, and that existing in other great industries: "The policy of the present Congress in this direction has been well demonstrated through the legislation already enacted authorizing co-operative marketing by agricultural associations. This legislation received practically the unanimous support of Congress, and if a method can be devised which will give industry a similar opportunity, and still prevent monopoly and restraint of trade, as already prohibited under existing statutes, Congress will certainly be contributing towards the solution of existing economic ills."

The committee suggested, if the proposed resolution shall pass, will make its report to Congress not later than Dec. 4, 1922.

We recommend support of the Edge resolution. We assume it has the support of Mr. Hoover.

The Chamber of Commerce of the United States has also appointed (April 3) a committee to study and report on trade associations, this committee representing various important industries, including agriculture and the coal industry, but, unfortunately, not the other mining industries.

The miners (we refer to them collectively, in the same sense as we denominate those interested in the agricultural industry "the farmers") will be interested in an extract from the bill whereby Congress granted the rights of co-operative action to the farmers, on Feb. 18: "That persons engaged in the production of agricultural products as farmers, planters, ranchmen, dairymen, nut or fruit growers may act together in associations, corporate or otherwise, with or without capital stock, in collectively processing, preparing for market, handling, and marketing in interstate and foreign commerce, such products of persons so engaged. Such associations may have marketing agencies in common; and such associations and their members may make the necessary contracts and agreements to effect such purposes."

It is further provided that the Secretary of Agriculture may restrain associations which use their functions to "unduly enhance" prices, and that he shall have final recourse, if necessary, to the courts, to sustain his decision.

Industrial Information

MR. HOOVER said in Washington, at the meeting with trade association representatives, that if the accumulation and publication of trade statistics were in themselves illegal, then the statistical information published in the newspapers concerning the industries must be abolished, and the industries would have to work on in the dark. "And in this case," he observed, "the United States would be bankrupt in ten years."

Mr. Samuel Untermyer, of New York, a distinguished attorney, made public a letter to Mr. Hoover, which was printed in the papers at the same time as the report of the conference of trade associations with officials of the Department of Commerce. In this letter he took Mr. Hoover to task for his attitude toward the encouragement of trade-association activities, and makes the silly argument that as Mr. Hoover is not a lawyer he is not fitted to deal with the question. We understand that Mr. Hoover had replied to Mr. Untermyer's letter, with the request that no publicity should be given to the letter unless his reply also was printed; but Mr. Untermyer did not, apparently, take note of this fair and sportsmanlike request. But in Mr. Hoover's speech in Washington to the trade-association representatives he observed that the problem of trade associations was not exclusively or even chiefly a legalistic one, but was an economic and industrial problem, and, therefore, within the scope of the duties imposed on the Department of Commerce by its organic act. Well said! Who gave the lawyers universal prescience and an exclusive right to maintain government by their querulous interpretation of obscure, hasty, and often unintelligent legislation? In Russia, in the gigantic experiment there, they scrapped the lawyers and the engineers and the merchants all together: but they have had to come back and beg for the engineer and the merchant to return; but so far they have not yearned a bit to have the lawyer back. In other words, in the category of prime necessities, they have, to say the least, not reached him yet.

Industrial Uses of Zinc

WHAT OF ZINC? Three or four years and more ago almost everyone knew of the campaign to "Make It of Zinc." Now, however, the ruling idea seems to be to make it of copper. Is the zinc campaign still on, and how far has it been carried? What new uses of zinc have been perfected? How do fabricators feel about the zinc situation?

Zinc is a young metal compared to copper and iron. It was not until the eighteenth century that the art of smelting zinc ores was known to Europeans and it was not until the nineteenth century that the metal was used in the arts extensively. Galvanizing was not invented until about 1837. Apparently, no great efforts were made to push the metal until the last decade. In the last few years, however, the American Zinc Institute has instituted an active campaign on behalf of the metal, and several individual companies have done even more than their share to advertise its merits. Chief of these is the New Jersey Zinc Co., and it is possibly owing to the fact that its advertising appropriation has been cut about 75 per cent during the last two years, while that of certain copper interests has been augmented, that the public feels that something must have happened to the zinc campaign.

The principal uses of zinc are for galvanizing, for zinc oxide (used in rubber and paint), and for brass making. These outlets for the metal are well known. They take possibly 80 per cent of the quantity produced. Definite figures are not available, but it is understood are being compiled by the American Bureau of Metal Statistics. The other 15 or 20 per cent goes into varied industries, but a fairly large part of it is rolled into plates and sheets, and it is in the use of these in the building industry that the principal chance for expansion lies.

To the layman, zinc is known chiefly through its use for galvanizing iron to prevent rust. The term "galvanizing," by the way, is unfortunate, for it conveys no hint of the name of the metal actually used. Between "galvanizing" and "spelter" zinc has had to struggle against a peculiar handicap—against aliases which are commonly used to cover up an undesirable career. But now that the public and zinc are becoming better acquainted there seems to be a greater tendency for the metal to come out and be known by its real name. Galvanizing, however, will be hard to replace. We might say zincking or zinc plating, or we might copy an idea

from the jeweler's use of "gold filled." This has always seemed illogical to us, however, for one would think a gold-filled article was filled with gold instead of being plated with that metal. Galvanizing will no doubt continue in favor for some time.

Although the use of galvanized pails and other articles demonstrated the value of zinc, we are not at all sure that familarity with galvanized iron has increased the respect in which the non-ferrous metal is held. Galvanizing, particularly in this country, is all too often done down to a price rather than up to a standard. The iron is given an extremely thin coating, and, what is worse, an uneven one, sometimes small spots being entirely missed. As a result, durability is not greatly increased, and the buyer gets the impression that zinc, although rustless, does not wear long. The zinc industry has a real problem in persuading galvanizers to turn out an honest product. The difficulty is, of course, that a poorly galvanized article looks just the same as the best, and unless a manufacturer establishes a reputation and a demand for a certain brand he will have a hard time marketing his somewhat higher priced product.

Increased use of automobiles has greatly enlarged the demand for zinc oxide as a filler to improve the resiliency and durability of automobile tires, for which its only competitor of importance is carbon black. It is also a valuable paint pigment, sharing the field with lead. Should the demand for rouge continue unabated we may come to speak of the "tonnage" going into this field, for the basis of many kinds of rouge is understood to be the common zinc oxide of the medicine shelf!

Brass contains varying percentages of zinc, and the demand from this industry is beginning to be more apparent, owing to the fact that the large tonnages of war scrap are practically exhausted. Some of the copper propaganda will affect zinc favorably in the brass field.

The newest and most interesting outlet for zinc is as a roofing and siding material, and for leaders and eavestroughs. This might be called largely a war development, for during the period of hostilities the zinc-rolling capacity of the country was largely augmented, and when peace came this equipment and experience went begging. However, the New Jersey Zinc Co., the Illinois Zinc Co., the American Zinc Products Co., the Anaconda Copper Mining Co., and others, in co-operation with the American Zinc Institute, determined upon an active campaign of public education to the merits of sheet zinc. They were aided in this by the recent production of a larger proportion of the more desirable electrolytic and high-grade zinc, and by the fact that many Americans had become cognizant of the advantages of zinc as a building material through war-time observation in Europe, where the metal has been used on roofs for nearly a hundred years without replacement.

To succeed, it is not sufficient to make a better mouse trap than one's neighbor, as Emerson suggested. The possible buyer must be taught that it actually is a better trap, how to set it, and the proper kind of cheese to use. Manufacturers of zinc building materials have had to combat not only ignorance and indifference as to the method of application and the efficiency of their product, but have also had to fight against an insidious attitude on the part of jobbers and roofers, inspired by the fact that repair work would not be so necessary or profitable where zinc had been used. However, much progress has been made, and inquiries are being received in a constantly increasing volume. Zinc shingles for houses are as permanent as the house itself, and in the present designs the butt-shingled effect of wood is secured. An oxidized surface of a slate gray color has been perfected which harmonizes well with ordinary forms of construction and finish. To be sure, the colored effects possible with copper cannot be secured, except by painting, but the cost is only half that of copper; in fact it is little if any more than that demanded for a good wooden shingle.

An objection offered to the use of zinc for eavestroughs and leaders is the high coefficient of expansion —it is about 2.6 times that of iron. This has been solved by the use of corrugations, slip joints, and improved methods of hanging. It only remains to make the buying public understand that old objections no longer hold.

As an industrial sheathing and roofing, corrugated zinc should have a wonderful future. By using a somewhat heavier gage and by making the corrugations deeper, a corrugated sheet has been developed only recently which can be laid on iron purlins spaced at conventional distances, without danger of collapse. By thoroughly painting the purlins before the sheets are laid, or by separating the zinc from the iron by pieces of asbestos, galvanic action is avoided and the roof will last indefinitely. Where corrosive gases are present, as at smelters, refineries, and chemical plants, the advantages of a properly laid corrugated zinc roof and siding should be great, but have hardly been considered as yet. In fact, in the chapter on "Roof Coverings" in Professor Ketchum's authoritative book on "Steel Mill Buildings," 1921 edition, the use of zinc is not even mentioned. However, the following statement does appear: "In 1898, the author saw at the Trail smelter, Trail, B. C., a corrugated steel roof made of No. 22 corrugated steel and painted with oxide of iron paint, that had corroded so rapidly in one year that one could stick his finger through it as easily as through brown paper."

Remarks by the Editor

COMMENTS on the journalistic "event" of the consolidation of *Engineering and Mining Journal* and *Mining and Scientific Press* continue to drift in from day to day.

The *Arizona Mining Journal* prints a little of the usual rubbish:

"The unfortunate part is that the Western country is now without a so-called national mining publication, one that is close to its problems; and that the national publication must now be published from New York City and imbued with the New York City idea of the Western mining industry and its general feeling that we are still in an uninhabited and wild country, and that we should be dominated by the financial interests of New York City."

Comment is obvious and therefore unnecessary.

The *Mining Journal*, of London, is owl-like in its ability to draw conclusions, saying, with the British prerogative of passing final judgment on the United States:

"The development illustrates strongly the centralizing tendencies operating at present in the United States, where the standardization of material is obviously begetting a corresponding tendency in the standardization of ideas."

A Daniel come to judgment—yea, a Daniel!

The *Financial News*, of London, however, helps to give us greater faith in Lloyd George as a Europe-doctor. It is businesslike and kind:

"The *Mining and Scientific Press* was founded in 1860;

the *Engineering and Mining Journal* in 1866. The papers have been rivals, but they have pursued the same policy in all essentials, and both have been spokesmen for the highest ideals of the mining profession and the best interests of the mining industry."

And the *Iron Age*, of New York, regarded by many as the leading iron and steel journal, takes cognizance of the union in a really critical and able editorial. Referring to the competition of technical journalism with society-subsidized publications, like *Mining and Metallurgy*, it says:

"Some of the engineering societies, after gaining numerical strength, in part by the help of technical and industrial publications which have been built up on their merits, have thought to capitalize the buying power of their memberships by going into the publishing business. Call it endowment or subsidy or whatever else, this use of the resources of such societies to establish a competitive business was never contemplated in their charter grants. It is a question, moreover, how far membership sanction would be given to these publishing enterprises if they were made the subject of a referendum. What has just taken place in the mining field may start some thinking on aspects of the matter that have not had much attention."

As for *Mining and Metallurgy* itself, its advertising agents, at least, were not slow in striving for a commercial advantage, and of our consolidation they write to engineers under date of March 18:

"*Mining and Metallurgy* has taken on greatly added importance since the announcement of the consolidation of *Mining and Scientific Press* and *Engineering and Mining Journal*. This, together with the pronounced improvement in the make-up and editorial policy of *Mining and Metallurgy*, and the fact that it is the official organ of the Institute and is owned and published by it, will, we feel certain, cause you to agree that its sphere of usefulness and influence would be greatly enhanced were we to include in it a comprehensive Professional Directory service. The charge for this service will be $36 per annum."

Ha-ha (sardonic laughter)! Here's to the money-making Institute! Why, we publish a professional card fifty-two times for $25 a year, friend Perlmutter? A topsy-turvy world! When the Institute is out after profits, and the *Journal-Press* after increased service at a lower upkeep, where, then, are our old-time notions?

A subscriber in the San Juan (Colorado), writing, not for publication, to the editor, thus comments on the use of the wireless to miners:

"Your editorial in the issue of Feb. 25 regarding the possible application of wireless to broadcasting *Journal* matter interests me, and I am prompted to write you about it. I have become a 'Radio Fan' myself to some extent, and perhaps my observations will be of some interest.

"I have placed in my home a first-class receiving set, Westinghouse make, and have taken an agency for the stuff as a side line during dull times and for the purpose of familiarizing myself with the possibilities, for I believe this will soon become a valuable adjunct to mining operations.

"My experience is probably typical of what would be that of the average individual in a mining district. I have not been at it long enough to determine many things, but I have learned the essentials. Nightly, I receive the day's news from Denver, a day ahead of our papers; I get the day's market reports and quotations; a great deal of music is broadcasted, some of it first-class music by regular artists. I do this with ease and in comfort—simply sit down in my home at a neat little table and outfit, turn the dial, and 'listen in.' It is marvelously simple and a fascinating study—offers plenty of scope for the man with the experimenting turn of mind, yet is compact and ready-made for the man who doesn't want to experiment. You can readily understand what an appeal this has for the dweller in a mining camp. I receive also other stations, but less satisfactorily; I receive innumerable telegraph stations, and their messages will become of much interest when I have learned to receive—understand—telegraph signals. As the thing progresses, I will get more and more things of interest, and from still other stations."

Somehow or other, by a kind of wireless telepathy, this puts us back in San Juan.

Our special European correspondent, Mr. Jacques Negru, mining engineer and graduate of the University of Liège, now in Europe after years of professional work in the United States, has sent us an interesting diary. What he says about his own native people is illuminating:

"The first impression one gets of the Belgians, judging from the appearance and actions of the people, is that they have become quite sober and do not show the same vivacity as before the war. They move about slowly, talk calmly, and are very simply dressed. There was scarcely any conversation in the compartments on the train. How very different from before the war! There are few automobiles on the street and practically no trucks. Flemish horses are still on the job."

The second of our series of marketing articles appears in this number. This article, by Charles Hardy, deals with the problem of marketing tungsten. It is a subject we should all know about. Mining schools should include the knowledge of marketing in their curricula.

Then in the field of non-metallic mining is the second article on the asbestos district of Quebec. This district is far and away the most important source of the world's asbestos, so we are naturally much interested in it; and this article deals with the mining, milling, and preparation of the mineral.

An article by Sydney Ball, on the copper metallurgy of the Central African natives, is of curious interest. The metallurgist, it appears, was rated even more highly in Darkest Africa than he is in our own land. Incidentally, community action and trade associations are outlined in their tribal customs. That certain mineral sulphides are storehouses of electric energy which may become of commercial value is shown by experiments described by G. N. Libby.

Engineers' Reports on Mines

THERE ARE conservative, ultra-conservative and timid mining engineers as well as careless, free-thinking, and courageous engineers. Their reports on mining properties vary accordingly. This is equally true of all branches of engineering. It is also true of business men. The ultra-conservative balance with the ultra-positive; the courageous with the timid. It is good for any industry to have this balance, as the average is probably the representative of the initiative which advances the industry in question.

Mining projects are accepted or rejected for a variety of reasons which are more or less not publicly expressed. Unless all of the facts are known, unless the specific instructions given to an engineer by his client are exposed, judgment of a report and of the engineer cannot be equitably made. No one can say that he played "safe" nor "ten-times safe."

The Functions of Institutes—II

BY T. A. RICKARD

IN a preceding article on this subject I ended with a compliment to the Institution of Mining and Metallurgy, stating that its success was due largely to the fact that the British mining profession was concentrated in London. Indeed, this geographic factor enters largely into the success of a national professional society. The wide extent of the United States and of Canada is one reason why the American and Canadian institutes have succeeded less well in serving the mining profession. The distance of most of the members from headquarters renders representation difficult. Those in control of the Institute have tried to obtain representative management by means of selecting directors from the various Local Sections, but the plan has broken down for the simple reason that engineers living at a distance from New York have neither the time nor the money to go thither to attend the directors' meetings. In consequence of their failure to attend, the control has passed into the hand of a small group of directors—six or eight—living in New York or in its environs; and they have acted for the whole board of 24 directors. Thus a coterie has exercised control, not necessarily because they have striven to obtain it, but by the logic of circumstance and also perhaps on account of the fact that they have given the Institute the financial backing that it has needed more than once during the last year or two. Thus the Institute has passed into the control of "a self-perpetuating oligarchy", as Mr. Spurr has phrased it in his presidential address before the Mining and Metallurgical Society. A sagacious leader of the profession, Mr. Philip N. Moore, has suggested that representation for the Local Sections at a distance be obtained by nominating persons resident in New York to serve for them on the board of directors. This is a palliative only, for those who live in New York soon lose touch with the West. The difficulty is geographic. The remedy is to develop regional—not local—Sections, and diminish the centralization in New York.

In discussing this subject, I assume that the principal functions of such a society are to promote the solidarity of the profession, to develop the idealism of public service, to further acquaintance and goodwill among its members, and to do these things by means of meetings and discussions. The publication of technical articles or papers or essays is incidental to the performance of its major social function. Whatever the conditions thirty years ago, it is easy nowadays for an engineer to find other means of publishing his writings, so as to reach the profession or the public. As for the discussions at the meetings, it is safe to say that they are less valuable than the conversations between members before and after the formal meetings. This is a phase of their social activities that is not sufficiently appreciated. The value of the printed discussions, on the other hand, is over-rated, because much that appears in them comes from persons with a bias. This is especially true of some of the controversies over the relative merits of proprietary devices and patented machines, concerning which a lot of rubbish has been printed in the Transactions of the American Institute, simply because there has been nobody sufficiently courageous (and sufficiently aware of the commercial ties of the speakers or writers) to apply the blue pencil vigorously. During recent years the meetings of the Institute have been utilized systematically by the representatives of manufacturers. I do not blame them; they are to be congratulated on their skill in using such occasions for the purpose of publicity; but, it may well be asked, how did they become members? They are not mining engineers, metallurgists, or geologists, and they do not pretend to be what they are not, although some of them were recruited from the ranks of the profession. The Transactions contain many papers on 'The Jones machine, by Jones', and 'The Smith process, by Smith', but the worst lapses are similar propaganda, in pseudo-literary form, with no acknowledgment of the business or commercial link between the subject of the paper and the writer of it. At some of our meetings the machinery agents have given the dominant tone, socially pleasant enough, but utterly stultifying to the dignity—that is, the scientific trustworthiness—of the technical discussion. However, despite the warnings of experience—particularly the experience of others, which is the easiest and cheapest kind of experience—the Canadian Institute is hungering for an expansion of its membership and a spreading of its activities, so as to become bigger—just as if mere bigness were not the curse of the modern world! Mr. Mackenzie is not content with enrolling the promoters and secretaries of mining companies; he desires the Canadian Institute "to expand logically along industrial lines", which he explains thus: "We must secure many more members from amongst the business men who have invested their money or are directing the investments of others, prospectors, salaried employees, and public-spirited citizens—and, in fact, take in all reputable persons who wish to identify themselves with us". Well, that is exactly what the American Institute has done from time to time, followed by spasms of selectiveness, as various presidents have been in temporary ascendancy. The result is a mob, not a technical society. It has been assumed that increase of membership would assure financial resourcefulness, whereas, of course, the increase of members has led usually to an expansion of the staff at headquarters, to the deputizing of duties, to swollen publications, to the careless use of money, and to the decay of vitality that follows spurious growth. Those connected with the periodical press know that an increase in the number of subscribers entails actual loss unless the new subscribers are of the same kind as those on whose support the paper has been built. Mere expansion is worse than futile unless it be in the right direction; that is, in the direction that leads to the fulfilment of the essential purpose for which the institute or the technical journal exists. It is not toward that kind of useful expansion that the Canadian Institute is heading; it will become, as the American Institute has become, a nondescript organization of all those connected with the mining industry; in short, a Mining Congress.

DISCUSSION

The Problem of Depletion

Solution Seemingly No Nearer in Spite of Space Devoted to Subject in Internal Revenue Regulations for 1922

REGULATION 62 of the Bureau of Internal Revenue contains what is supposed to be the last word on depletion. Is the problem any nearer solution than it was three years ago?

"Art. 206. *Determination of fair market value of mineral property other than oil and gas.* . . . The value sought should be that established assuming a transfer between a willing seller and a willing buyer as of that particular date. . . . Valuations by analytic appraisal methods such as the per cent value method are not entitled to great weight: (1) If the value of a mineral deposit can be determined upon the basis of cost or replacement value, (2) if the knowledge of the presence of the mineral has not greatly enhanced the value of the mineral property, (3) if the removal of the mineral does not materially reduce the value of the property from which it is taken, or (4) if the profits arising from the exploitation of the mineral deposits are wholly or in great part due to the manufacturing or marketing ability of the taxpayer. . . ."

Can anyone imagine an instance where the buyer of a mine was unwilling?

The cost of most mines is represented upon the books of the company by a charge to property account, and a corresponding credit to capital stock, or probably the vendor accepted a cash payment and the balance in stock having a par value of say $5, which went on to the New York Curb at $1.75 and then went down to 37½c. and stayed there. What did the mine cost the company? If it paid all cash, it's plain sailing, unless the company afterward "discover" the presence of mineral greatly enhancing the value of the property.

Depletion was supposed to be (notice I say "was") a deduction from income allowed by the Government for the purpose of reimbursing the owner for the cost of the property. If, therefore, a property was purchased for $200,000 on the assumption that it contained enough ore to pay a profit on the purchase price, (the cost of development and equipment having been taken into consideration as a future charge against ore extracted, in figuring the possible profit), and it is afterward found that the mine contains more or higher-grade ore than was expected, does this discovery increase the original cost of the mine? Depreciation is a deduction allowed from income, of an amount sufficient to replace equipment or plant when it is worn out. It must be figured on cost, not on value. It might have cost considerably less than it would have later, but the taxpayer is not allowed to take advantage of the enhanced value. It would be a peculiar sort of mine which would not be reduced in value by the removal of its contents.

If a mine is being profitably worked, because of good and efficient management, that fact puts another phase on the question of valuation. Who is to decide this point? Based on experience as to recovery cost and selling price, "the number of units recoverable in marketable form multiplied by the difference between the selling price and the operating cost per unit gives the total expected operating profit. The value of each mineral deposit is then the total expected operating profit from that deposit reduced to a present value as of the basic date . . ."

Records and data are no criteria as to what will be in, say, ten years from now. Several of the larger mines have from twenty-five to fifty years' ore in sight. Who knows what the average selling price of copper is going to be during the next twenty-five or fifty years or how much costs will be reduced and recoveries increased by improved mining and milling methods? The whole trouble over depletion arose over the wording of the law.

If a property was acquired after March 1, 1913, the basis for depletion charges is the *cost* of the mines, mills, and other holdings. If prior to that date, the fair market *value* on that date. No one has ever been able to figure the value on March 1, 1913, of a mine acquired and worked prior to that date. The law contemplated an allowance to return to the owner in years subsequent to March 1, 1913, that part of the cost of the mine applicable to those years when purchased prior to March 1, 1913. But it didn't say so in words anybody could understand. In years prior to 1913 no one had ever seen a depletion account on mining books. Some lawyer Congressman had it in his head without doubt, but could not say it. He wanted to say that the Government would not be responsible for that part of the cost of a mine applying to any period prior to March 1, 1913. He knew that, if the cost was credited with something represented by the ore taken out prior to that date, the balance on March 1, 1913, would be what the Government would allow to be deducted, but he said "*value*," and consequently mines were all worth on March 1, 1913, more than they cost, notwithstanding development work had been charged off against ore as mined.

If each separate mining company is to be allowed to do the guessing, and these guesses become a source of controversy with the Internal Revenue Bureau, which maintains a special division called National Resources for the purpose of making contra guesses, why not let the Government do all the guessing and furnish a factor to be used for fixing depletion in the mining of each mineral and also the production of oil and gas, this factor to be changed each year as production costs and selling prices increase or decrease? This would save the Government millions of dollars in the Natural Resources Division of the Internal Revenue Bureau and cut down the income of a lot of high-brow accountants who are reveling in the intricacies of the present law.

Two good men in the Natural Resources Division can in a month compile all the guesses made for three years on depletion per pound or per ounce of the different metals, per barrel of oil, per 1,000 ft. of gas, timber and other things, and strike an average. Reduce that about 25 per cent and hand the results out to be used

as the standard factors for 1922. Fire several hundred employees and cut down expenses, which the taxpayers are paying. Cut out the bunk and get down to results.

Washington, D. C. C. B. HOLMES.

Cheap Copper

A rearrangement of prices has been going on throughout the world since the autumn of 1920. This rearrangement was bound to come after the Armistice, when the artificial high level of prices brought about by the Great War collapsed, and with it the policy of production without regard to cost. The metal industry has suffered perhaps more than any other while this painful and necessary process has been going on, and most of the big copper mines have been obliged to shut down while the large stocks of that metal produced for war purposes and at high cost were absorbed by the peace-time industries.

Copper has reached a price now that will allow the mines with the lowest costs to start up, and if worked at their maximum capacity—which is, of course, also the most efficient—to make a profit, though small. Here is where an important point of policy, and one which will have a profound and far-reaching bearing on the future of the metal industry, comes in. What would serve the interests of the industry best? That those producers with the lowest costs should resume operations at once, or wait until the now diminishing stocks of copper are absorbed completely so as to cause an artificial high price that will allow the high-cost producers to make a profit also? I believe that the second policy would be detrimental, not to say suicidal, to the best interests of the industry as a whole, and for many reasons.

Let us take, for the sake of simplicity, the copper industry as an example. What can be said with regard to copper will apply equally well to the other metals. Our civilization is becoming every day increasingly dependant upon the metals. Of these, none has become so necessary of late years as copper.

The scarcity of copper and copper alloys during the war caused inferior substitutes to be employed in their place, and though the first cost of these substitutes is much lower than the cost of the nobler metal, over long periods of time they become much dearer because of their necessary periodical renewal. Nothing like cheap copper, besides the necessary campaign of educating the public, would make the red metal regain the lost ground. Not only would this be regained but new fields would be conquered and new uses be found for copper. All this is dependent, every one will admit, on cheap copper. Cheap copper, *the cheapest copper possible*, would permit the maximum and most efficient working of the mines at all times, because a steady and sure demand would be created and the industry would not be subjected to alternating periods of inflation and depression, or at least these would not be so frequent.

There is nothing like maximum production and low prices to insure maximum efficiency. I know that a close adherence to this policy of cheap metals would mean that the high-cost mines would be sacrificed and that the profits to the low-cost producers would not be so large as with high prices, but though the profits would be smaller they would be more constant. Steady though smaller profits would place the industry on a surer basis than large fluctuating ones, and would make mining, at least base-metal mining, more of an investment than a gamble, as the dividends would come more steadily.

To prop up the high-cost properties by causing a high artificial price through restricted production would be a wrong policy. It is a well-known fact that there is nothing so conducive to inefficiency as high prices and large margin of profits. Let us remember what happened during the war. Under the stimulus of high prices *production at any cost* became the motto, and nobody troubled about *the cost of production*. High prices make for inefficiency, as they tend to level up costs, not by lowering those of the inefficient but by raising those of the efficient. The struggle for efficiency and low costs comes about when the margin of profits begins to disappear. If it is necessary to sacrifice the marginal copper mines, let them be sacrificed, for the sacrifice will redound to the benefit of the industry as a whole.

Let us take two widely different industries and compare what happened to each of them under the opposing policies of their directors at the close of the war. The nitrate industry tried to maintain Chilean *salitre* at the high price it reached during the war, and to effect this purpose the Association of Producers fixed the price without regard to the state of the world's markets. What have been the consequences? The industry is today practically dead and nearly all the *oficinas* are idle. This means, of course, that the investors are not getting dividends for the capital invested. The Chilean government is not getting, either, any export duties from the nitrate. Result? That the American dollar is worth 10 chilean pesos and the pound sterling 45, in comparison with 3 and 15, respectively, when the export of *salitre* was at its height. Also, Chile is experiencing the worst financial crisis that the country has ever had to meet.

The Chilean nitrate industry offers the best example of what a monopoly can do for an industry. As *salitre* always had a good market until recently, no matter at what price it was sold, for it had no competitors, there was no incentive to cheap production, and the technical methods of beneficiation remained stationary, with less than a 60 per cent recovery, a worse condition than that existing in any other great industry in the world. There has been practically no progress for forty-five years.

Markedly different to this story is what happened to Mr. Ford's enterprise. Mr. Ford saw that if he wanted to sell automobiles to a much poorer world he would have to sell them at the same, or, better still, at a lower price than when money was more plentiful than it is now. He realized that a low price, the lowest price possible, was necessary to obtain large sales, and that these were the only means of keeping his plants working at maximum capacity and resultant high efficiency. Low prices and maximum capacity are interdependent. The one cannot exist without the other. The result has been that Mr. Ford's enterprise has been adversely affected by the world crisis to a less degree than any other great industry.

Cheap copper would enable the industry to work at maximum capacity for long periods of time. Steady production with a maximum output would create and develop that efficiency which would increase with time, and the cost of production would tend to decrease rather than to increase. Steady employment to the labor force would produce contentment and would induce in the workers a desire to remain where they could obtain constant employment. They would also be content to

work for smaller wages than in an industry where dismissal might come at any time and where they would be forced to save up for bad times.

Of course, there always remains the danger of overproduction and the collapse of the market through this cause, but I do not think that the danger would be great in the case of copper, as this metal, offered at a reasonable price, is bound to be used in the future in a greatly increasing number of industries. F. BENITZ.

Santiago, Chile.

The Element of Chance in Drilling Alluvial

The statements made by Wilbur H. Grant in his paper on "The Valuation of Placer Deposits," which was published in the *Engineering and Mining Journal* of Feb. 25, 1922, are of so startling a nature that they demand close investigation before they can be accepted. Present methods of testing placer ground are roundly condemned, and a call is made for eight times the number of holes per unit of area customarily put down in average ground. This attitude evidently arises in great measure from the comparison he institutes between the usual close spacing of cuts in lode sampling, and the wide spacing between holes in drilling alluvial. He states, "As the amount of material in a drill hole sample is only a small part of the whole placer deposit, no great number of improvements in the refinements of the mechanical details of sampling and computation would have nearly as great an effect on the final results as has the irregular occurrence of the valuable mineral in the gravel. Consequently, the deliberate or accidental location of holes has vastly more influence on the valuation of the deposit than all the other forty-nine or more variables put together." Again, "The accuracy will increase as the ratio of the quantity of the sample to the amount of material in the deposit increases." This last statement is certainly not true to any material extent as it stands. If "number of samples" were substituted for "quantity of the sample" it might be tolerated.

As pointed out by Eugene H. Dawson in the same issue of the *Journal*, drilling, in an established field, resembles the exploration and development practiced in lode mining, and its cost is a legitimate part of the cost of dredge operation, but much drilling is more to be compared with wildcatting for oil, and the investor is going to be chary of investing in the business if he is told beforehand that unless the prospective area is closely drilled at considerable expense the results will be utterly untrustworthy.

There is an extensive mathematical literature on the laws of chance, of error, and of probable deviations from the truth in a series of observations, but this relates only to cases where a definite magnitude is observed, the measurement of which is subject to small unavoidable errors. It is possible, for example, to calculate the largest probable number of instances of deviation from the mean (evens) in matching a large number of nickels. There is also a theory of sampling, showing the limits within which error will probably be confined by taking a sufficiently large bulk of a sample from material whose particles are of a given average size, and it is perhaps worth while to point out that this bulk does not in the least depend on the total bulk of the material which is being sampled. But nothing of the kind appears to be applicable in the present case, where we are concerned with the determination of a mean value by the measurement of a large number of independent values which will be found to differ widely among themselves.

The determination of the average value of an alluvial deposit by drilling may be compared to the determination of the mean elevation of a block of territory by a series of arbitrarily placed spot levels. Similarly, it may be compared to the determination of the mean elevation along a section line by leveling, but where the observer receives no guidance from the actual character of the ground as he views it, but spots his rod at more or less regular distances. Such a section may be either practically horizontal, a fairly regular steep or gentle undulating slope, or wildly irregular in gradient and elevation, with a number of irregularly distributed high and low points of different elevations among themselves. The three categories into which Mr. Grant divides alluvial deposits may thus be represented. Anyone can draw such a section for himself, determine its mean elevation carefully by reading off closely spaced ordinates, and then see what means he obtains by wider spacing of the ordinates, placing these at regular intervals, but starting at a different point each time. I strongly recommend anyone interested to do this. It will restore confidence, should this have been shaken by recent revelations. It is surprising how difficult it is to draw a sufficiently jagged section, if it is of reasonable length, to obtain any serious deviation from the average.

Mr. Grant's alarmist view seems to be altogether due to his belief that the ratio of the volume of the sample to the volume of the material sampled is a criterion of accuracy in alluvial sampling. Such is actually not the case at all.

In computing values, although the practice of different engineers varies according to individual idiosyncrasies, the basic assumption always made is that the values at points intermediate between those where the samples are actually taken vary regularly between those points, and inaccurate results, or discrepancies between drilling and dredging results, where they are not due to the dredge itself, or to actual errors in individual samples, or to a consistent error throughout, as would arise from the adoption of an incorrect factor, are due to this assumption being incorrect. Nobody supposes that it is literally true, of course; what is assumed is, that in a sufficiently large number of point-to-point cases those where a plus error is introduced in consequence of this assumption will be balanced by those into which a minus error is introduced, and the efficiency of close drilling lies not in the fact that it produces finally a larger bulk of samples, but that the probability of serious departure from the rule of regular variation from point to point will be less as the holes are closer together; and, further, that as a larger number of these point-to-point cases are taken together, the law of averages will work out so that there will not be any great excess of the one case over the other. This is about the only place where the mathematical law of averages operates at all in relation to alluvial sampling.

The law of averages is usually stated thus:

1. Plus and minus errors are equally likely.
2. Large errors are less common than small ones.
3. Very large errors do not occur.

London, England. R. T. HANCOCK.

Inheritance and Industrial Unrest

Touching upon the problem of the present unrest, it is rather strange that more prominence has not been given to the abolition of inherited wealth as a cure, and the simplest cure, for most of the existing differences between capital and labor. The gradual abolition of the privilege of inheritance would solve most of the world's present difficulties without interfering with the ordinary functions of the governments and without seriously interfering with present industrial institutions. The industries of the world are tending toward greater consolidation, and not toward disintegration; toward co-operation, and not toward competition. There is no objection to that. The difficulty comes in the distribution of the earnings. In considering this problem a fundamental distinction must be made between earned wealth and unearned wealth.

It can readily be shown that from 50 to 75 per cent of the earnings of the heads of poor families goes to support and to increase the unearned fortunes of the rich. This burden is getting hard to bear, and is the fundamental cause of the present unrest, when it is considered that fully 80 per cent of the people of the United States may be classified as poor.

Socialism has been given a great deal of consideration, but socialism leads to communism, for, if it is desirable to socialize some industries, there would be no stopping place until all industries were socialized, and this, in effect, would be communism. Whether communism is desirable or not is another matter.

The bonus system has been given a great deal of consideration, but the bonus system will not meet the conditions, and, in the end, would lead to communism; for if labor is entitled to a part of the earnings, aside from its wages, it will be seen that it can demand more and more, until finally it can demand all the earnings.

Government regulation has also been given a great deal of prominence, in the discussions between capital and labor. Manifestly, again, if one industry can and should be regulated by the government, all can and should be so regulated. We would then have government by regulation instead of government by representation. This would perpetuate, and not eradicate, the present evil. In the end, it would no doubt lead to government ownership—that is to say, socialism.

It would seem as if the present tendency of solving the problem of unrest is toward a mild form of socialism, either as represented by the socialists themselves, by an enlargement of the bonus system, or by an enlargement of government regulation. It is believed that neither of these remedies offers the best way out of the difficulty. The one remedy which would meet all the essential conditions is the gradual abolition of the privilege of inheritance. This could be done without much shock to existing institutions. It would be in line with American ideas and American ideals.

The Declaration of Independence, which has always been the basis of American liberty, says: "We hold these truths to be self-evident, that all men are created equal; that they are endowed by their Creator with certain unalienable rights." Surely, no one would say that men are created equal, when the children of the poor are born into the world free of any crime save that of the poverty of their parents, yet sentenced to pay a large portion of their life's earnings to other children, simply because the ancestors of the other children had acquired wealth. If any one doubts the evils of inherited wealth, let him ask why one child should inherit undeserved poverty and another undeserved wealth, and if he did not know in advance which child was his he would do some thinking. Inheritance is an offence against society; it is an offence against the inherited; it is an offence against the disinherited. It is also an offence against American traditions.

Lincoln, in one of his speeches, said: "But it has so happened in all ages of the world that some have labored and others have without labor enjoyed a large portion of the fruits. This is wrong and should not continue. To secure to each laborer the whole product of his labor, or as nearly as possible, is a worthy object of any good government." In this connection it might be well to ask how, or when, or where, did an heir labor for a dollar which he inherited. He gets without giving; he reaps without sowing.

Jefferson, who was certainly the greatest statesman and one of the greatest patriots that America has yet produced, says: "These are axioms so self-evident that no explanation can make them plainer: That our Creator made the earth for the use of the living and not of the dead; that those who exist not can have no use nor right in it; no authority or power over it; that one generation of men cannot foreclose or burden its use to another, which comes to it in their own right and by the same divine beneficence. . . . Habit alone confounds civil practice with natural rights."

Blackstone says: "There is no foundation in nature or in natural law why a set of words upon parchment should convey the dominion of land: why the son should have the right to exclude his fellow creatures from a determinate spot of ground because his father had done so before him."

In a court decision rendered in Pennsylvania, it was said: "There is no provision of our Constitution or that of the United States, which secures the right of any one, whether kindred or not, to take property by inheritance. Descent is a creature of the statute and not a natural right."

Carnegie says, in his "Gospel of Wealth," that: "The Almighty Dollar bequeathed to children is an almighty curse." The late William K. Vanderbilt said, in 1905: "Inherited wealth is a big handicap to happiness. It is as certain death to ambition as cocaine is to morality." Only within the last few weeks, Henry Ford remarked: "It would be said that people bought these (railroad) stocks for the financial protection of their families, their children. Protection from what? From the necessity of earning their living. Their children would be better off if they had to finance themselves."

The abolition of inheritance would largely, if not entirely, automatically solve the problem of the present social, industrial, and political unrest. With the abolition of inherited wealth, every one would get all, or nearly all, that he earned, and there would be no cause then for strikes or labor agitation. There would be capital, as now, but no permanent capitalistic class. The differences between capital and labor would die a natural death, the same as did the conflict between plebian and patrician with the abolition of inherited nobility, and the same as did the conflict between the North and the South when inherited slavery was abolished. The abolition of inheritance would not involve any injustice to anyone. It would be in the nature of restitution, and not of confiscation.

Denver, Col. WILLIAM E. GREENAWALT.

Marketing Tungsten Ores

Domestic Production Now Dormant—Tungsten Used Industrially in Alloys, Pigments and for Lamp Filaments—Markets Are Hamburg, London and New York—World's Consumption Estimated To Be 15,000 Tons of Ore

BY CHARLES HARDY

TUNGSTEN seems to have been known for many years, but its use on any large scale began only about fifty years ago. It was used by the sword makers of Damascus in the Middle Ages, as most of the swords of that time which have been examined show a certain percentage of tungsten in their composition.

Tungsten, known also as wolframite, an older name, is first mentioned in literature toward the latter part of the sixteenth century in the works of Lazarus Ercker. Wolframite was then known only as a compound which interfered with the reduction of tin ores, with which it is generally associated. It was not realized that this detrimental impurity contained a new element. The discovery of tungstic acid as a new compound was made by Karl Wilhelm Scheele in 1781. The compound of tungstic acid and calcium known as scheelite was named after him. A Spaniard named Elhuyar, in 1786, was probably the first to utilize tungsten with steel. The amount of tungsten used until the middle of the nineteenth century was inconsequential, and all the work done up to that time must be classified as experimental.

In a publication which appeared in London in 1807, Frederick Accum states that tungsten "is not employed yet, but promises real utility, on account of its coloring properties, as a basis for pigment, since the compounds, it is said, form with vegetable coloring matters and afford colors so permanent as not to be acted on by the most concentrated oxigenated muriatic acid, a great enemy of vegetable colors." Of the tungsten compounds, the same authority says, "The salts are very little known."

About the year 1860, efforts were made to utilize tungsten in the manufacture of rails, and at Terrenoire, France, rails containing 5 per cent of tungsten were manufactured. The high prices quoted in those days for tungsten ores prevented its immediate application on a large scale. In a book issued by Heinrick Leiser, reference is made to the price in 1860, 1,400 marks, or the equivalent of approximately $150 per unit. A British patent by Oxland, covering the manufacture of sodium tungstate, and the process of converting the ore into sodium tungstate before reducing it, gave the industry considerable impetus. At the Paris International Exhibition in 1900, the first utilization of tungsten in the tool and high-speed steel industry was shown, by exhibits principally on the part of the Bethlehem Steel Co. (the so-called Taylor White steel). Closely following the application to high-speed and tool steel, tungsten was employed in the manufacture of lamps, with which the names of Dr. Just and Dr. Hans Kuzel will always be associated.

Tungsten is used in a variety of products. Its principal application is in the high-speed tool industry. It also finds regular uses in the following trades: As a metal—in the electric lamp industry; in replacing platinum for contact points in the automotive and telegraph industries (wireless apparatus); in dentistry to replace platinum pins; in phonograph needles; in shell steel, and in chemistry to replace a number of platinum chemical apparatus. As ferro tungsten—for making alloy steel, magnetic steel, and other similar products. Tungsten is also used in the manufacture of non-ferrous alloys, as it alloys with most other metals. Tungsten compounds are used in the manufacture of colors. In combination with barium a white color is produced; with nickel a light green; with chromium a dark green; with cobalt a blue, and used as tungstic acid alone, a yellowish color is formed. Tungsten is further used for impregnation and as a mordant in the cloth industry. Stellite is an alloy of cobalt, chromium, and tungsten, and other alloys have been made of copper, nickel, and tungsten. Platinoid is 60 per cent copper, 25 per cent zinc, 12 to 14 per cent nickel, and 1 to 2 per cent tungsten. Sideraphit is a composition of iron, nickel, aluminum, copper and tungsten. Other alloys of tungsten are also known. Scheelite has been used to a considerable extent in X-ray technique.

TUNGSTEN ORE USERS IN THE UNITED STATES

During the war the following works, in the United States, were consuming tungsten ore, and though a number of these are not at this moment operating, owing to the general commercial condition, with a revival of trade most of them should again resume activity:

The Crucible Steel Co. of America	Pittsburgh, Pa.
Primos Chemical Co., (*a*)	Primos, Pa.
Firth Sterling Steel Co	McKeesport, Pa.
Latrobe Electric Steel Co	Latrobe, Pa.
Vanadium Alloy Steel Co	Latrobe, Pa.
Hudson Reduction Co	Latrobe, Pa.
Penn Electric Smelting Co	Philadelphia, Pa.
E. J. Levino & Co	Philadelphia, Pa.
Electric Reduction Co., (*b*)	Washington, Pa.
Fansteel Corporation	Chicago, Ill.
H. L. Hollis	Chicago, Ill.
Tungsten Products Co., (*a*)	Baltimore, Md.
General Electric Co. National Lamp Works	Cleveland, Ohio
General Electric Co	Schenectady, N. Y.
Ludlow Steel Co	Albany, N. Y.
Atlas Crucible Steel Co	Syracuse, N. Y.
Electro Metallurgical Co	Niagara Falls, N. Y.
Metal & Thermit Co	New York
Chemical Products Co	Washington, D. C
Black Mountain Co	Boulder, Col.
Tungsten Products Co., (*c*)	Boulder, Col.

(*a*) Gone out of business.
(*b*) Now operating under title of Molybdenum Corporation of America.
(*c*) Now operating under title of Radium Co. of Colorado.

GEOGRAPHICAL DISTRIBUTION OF TUNGSTEN ORES

Prior to the war the important sources of tungsten ores were Burma, Australia, New Zealand, North America, South America, Portugal, and Siam, each of which produced more than 750 tons per annum. During the war the developments caused by the large demand and the stimulation of the high prices shifted the production centers considerably, and China, which prior to 1914 was not known as a producer of tungsten ore, became the largest producer in the world.

Tungsten is found widely distributed all through the world. Scandinavia, Russia, Germany, Austria, France, Spain, England, Canada, Alaska, Mexico, Bolivia, Peru, Argentina, South Africa, and the Straits Settlement all

contributed during the war toward the huge production of approximately 32,000 tons.

Marketing Points—Until 1914, the best marketing point for tungsten ore was Hamburg, as Germany reduced most of the tungsten ore mined in the world to either the metal or ferrotungsten. Though 50 per cent of the ore at that time was found in the British colonies, and a like proportion, if not more, was consumed by the British steel industry, the German industry had control of the conversion of the ores. During the war the marketing of tungsten ore shifted, and, in addition to Hamburg, London and New York are now important marketing centers for tungsten ores.

Consumption—The production of tungsten ore has practically kept pace with the consumption of tungsten, and any increased production has been absorbed by the new uses discovered for tungsten. The world's annual production from 1898 to the present is given in Table 1 and in Fig. 1. In 1917, a production of 25,523 tons was reached. This tonnage was actually consumed.

It was anticipated, had the war continued, that a total of 25,000 tons per annum would not be equal to the requirements, and all governments urgently put forth special effort to increase their production. The sudden ending of the war, however, cut down the consumption considerably. The highest production ever reached, in 1918, was 32,000 tons, followed by the production of 20,000 tons in 1919 and 11,000 tons in 1920. This was more than the industry, disorganized by the signing of the Armistice and the consequent withdrawal of the war demand, could possibly absorb. The accumulation of ore here as well as in Europe had made it impossible to gage accurately the present position, and now the world's consumption of tungsten ore is estimated not to exceed a total of 15,000 tons per annum.

Requirements as to Content and Purity—Tungsten is found as tungstic oxide in combination with other elements. The principal minerals are:

Wolframite $(Fe,MnO)WO_3$, tungstate of iron and manganese.	Powellite $Ca(MoW)O_4$
	Tungstite (WO_3 H_2O)
	Stolzite ($PbWO_4$)
Ferberite (FeO WO_3), iron tungstate	Rospite ($PbWO_4$) (different crystallization)
Hübnerite (MnO,WO_3), manganese tungstate	Cuprotungstite ($CuWO_4$ $2H_2O$)
	Ferritungstite (Fe_2O_3 WO_3 $6H_2O$)
Scheelite (CaO,WO_3), calcium tungstate	Tungstenite (WS_2)

Tungsten ores are generally grouped into two classes: (1) Wolframite—in general, includes the black ores. (2) Scheelite—includes tungstic acid in combination with lime.

Tungsten ores vary considerably, and hardly any two mines produce like ores. Though in general tungsten ores are marketed on the basis of 60 or 65 per cent tungstic acid (WO_3) and better, the trade likes to buy a known product of a given mine or ores upon which the analysis is guaranteed.

Ores are generally classified according to the type of reduction applied by the buyer. The manufacturers of tungsten salts or lamps can use different grades. The reduction of tungsten ores may be divided into three classes: (1) Chemically, as in the manufacture of sodium tungstate and reduction to metallic tungsten powder or the making of yellow tungstic oxide for pigment or other purposes. (2) By the electric furnace, with ferrotungsten as a product. (3) By the Thermit process.

In the chemical process, most of the impurities objectionable in other processes, such as tin, copper, phosphorus, arsenic, sulphur, and manganese, are eliminated, and a buyer applying chemical treatment can use almost any ore. In the manufacture of ferrotungsten by the electric furnace, it is essential to have an ore as free as possible from impurities, as, in the process of fusing, the impurities would enter into the finished product. A desirable quality of ore for this class of buyer should be one containing more than 65 per cent tungstic acid and not more than 0.05 per cent each of tin, copper, phosphorus, arsenic, and sulphur. In the Thermit process the highest quality ore, free from impurities, is wanted.

The quality requirements called for in groups (2) and (3) make it impossible to sell certain ores, or incumbent upon the producer to subject the ore to special treatment—magnetic separation for the elimination of tin, copper, lead, and other impurities; or where an excess of phosphorus is present, the dephosphorization process by acid treatment is employed; sulphur and arsenic are eliminated by roasting. Typical analyses are given in Table 2.

The coarseness or fineness of the material is immaterial to any user. Tungsten ores reach the trade from a fist-size down to a fine powder. The former is generally the result of hand sorting, and the fine powder the product of table concentration or electromagnetic separation.

Wolframite, ferberite, and hübnernite all show the same physical characteristics. All three are subject to electromagnetic treatment. The presence of tin, copper, antimony, arsenic, phosphorus, bismuth, and sulphur reduce the value of the ore. No definite scale exists by means of which to adjust the price, because of impurities. The price is fixed by the individual negotiation between buyer and seller.

No definite ruling exists governing the quantities sold, although in this country buyers prefer to purchase in carload lots. Material shipped from an American mine can easily be handled in this way, but the foreign ores reach New York in quantities varying from a few bags to fifty tons.

Penalties and Premiums—No accepted practice has been evolved covering the premiums or penalties. At one time a premium was paid for material running over 65 per cent tungstic acid. However, as the available stocks are exceedingly heavy, sufficiently high-grade material can now be had without buyers having to pay a premium.

The ore is weighed and sampled at the buyer's works if sold before arrival; otherwise, the sampling is done, at port of arrival, by quartering or by automatic samplers. The general tendency on the part of the samplers has been to sample lumpy ore by taking approximately a 30 per cent sample of the material; fine concentrate by taking about 10 per cent. The final sample is reduced to approximately 10 to 15 lb. and taken by the chemist for analysis. Weighing is generally done in drafts of six bags.

Analyses for tungsten and the impurities are made from these samples. In most countries the analyses of certain recognized chemists are accepted by buyers and sellers as final. Only in rare instances is the assay determined by two chemists, and in such event the mean of the two assays is the basis for settlement. The tolerance is one-half of 1 per cent. If the difference is larger a referee assay is made. This is averaged with the one nearest to it, and the mean of the two is accepted for the final settlement.

Transportation Requirements — Tungsten ore is

shipped in double bags. The size of the bags varies between 200 to 224 lb. per bag. Bags are generally returnable to sellers.

Value Computation—The accepted measure used in computation of the value is the so-called unit. One unit equals 1 per cent. In the United States, the short ton is generally adopted as the basis for calculation, and one unit is, therefore, equivalent to 20 lb. of tungstic acid (WO_3). In England and the British colonies, the English ton is the basis; in France and Germany the metric ton. A unit is equivalent to 22.4 lb. in the former, and 22.08 lb. tungstic acid in the latter countries.

Terms of Settlement—Domestic ores are shipped to the buyer's works. A preliminary invoice calling for payment of 90 per cent is attached to the documents. Foreign ores are paid for at the rate of 75 per cent of the preliminary invoice against documents, and in both transactions final settlement is made immediately upon determination of weights and analysis by a mutually approved chemist. Between the importer and the foreign shipper, the method of settlement is also on the basis of 75 per cent advanced against the documents. In many transactions a credit is obtained for this amount.

Marketing Problems and Conditions Influencing Prices—Tungsten ores should be cleaned by concentration to as high above 60 per cent as possible. The higher the percentage of tungstic acid in the concentrates the smaller the losses in the production of ferrotungsten. Hence, buyers can afford to pay the top market price for a high concentrate.

Tin, bismuth, copper, lead, antimony, and iron are generally eliminated by electromagnetic separation, which is best done at the mine itself. There are in the United States, England, Germany, and France works which clean concentrates by magnetic separation on toll. The average cost of such separation is from $30 to $35 per ton. If sulphur is present, roasting of the ore is advisable. During this roasting arsenic and phosphorus are generally eliminated or considerably reduced. The dephosphorization alone has been successfully achieved by treatment with diluted sulphuric or muriatic acid under injection of live steam during the process. If tin, copper, lead, and bismuth are present in sufficient quantities, a further concentration of the tailings for the recovery of these impurities is advisable. Usually, any ore showing tin, copper, or bismuth in excess of 1 per cent will pay for this procedure.

Imports and Exports—The imports of tungsten ores totaled 1,441 tons, of a valuation of $276,757, for the year 1921. This compares with 1,740 tons imported in 1920 and 8,400 tons in 1919. Of the 1,441 tons imported in 1921, China's share is more than 75 per cent.

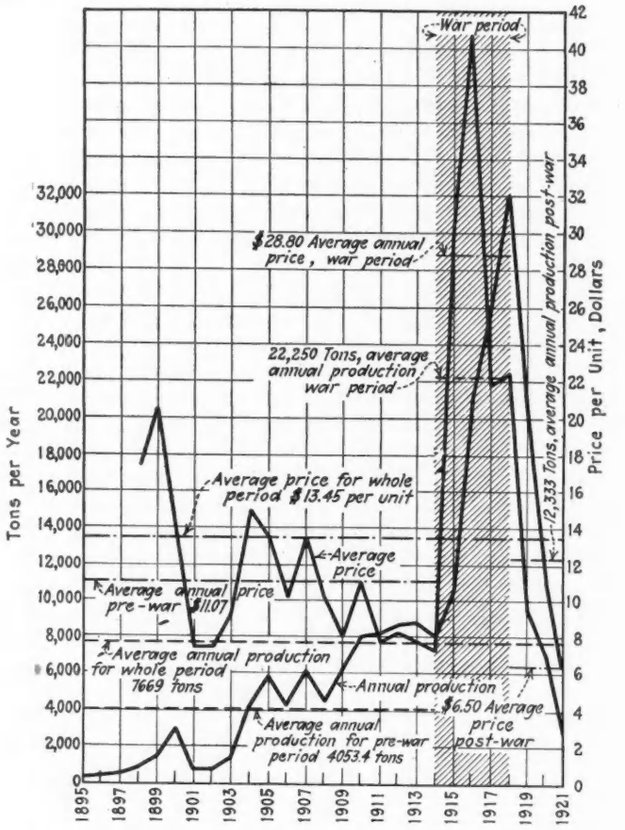

War period
$28.80 Average annual price, war period
22,250 Tons, average annual production war period
Average price for whole period $13.45 per unit
Average price
Average annual price pre-war $11.07
Average annual production for whole period 7669 tons
Annual production
$6.50 Average price post-war
Average annual production for pre-war period 4053.4 tons
12,333 Tons, average annual production post-war
Tons per Year
Price per Unit, Dollars

Fig. 1. Prices and world production of tungsten ores

During the whole of 1921, the maximum price for tungsten did not exceed $3 per unit, and it will readily be seen that no other country but China could produce in quantities at this level.

The influence of imports upon the price of tungsten ores in the United States market is naturally great. The importation of Chinese ores has brought the mining of tungsten ore in the United States to an entire stop. Chinese ores are produced by surface mining at a low cost, and of late probably 70 per cent of the total importations originated in China. The tungsten mines of the United States, and those of Argentina, Chile, Bolivia, Peru, Portugal, and Spain are reported closed

TABLE I—THE WORLD'S APPROXIMATE PRODUCTION OF TUNGSTEN ORES AND PRICES FOR EACH YEAR

Year	Quantity Short Tons	Price per Unit in Dollars	Year	Quantity Short Tons	Price per Unit in Dollars
1895	103	.....	1909	6,200	$8.00
1896	182	.....	1910	8,000	11.00
1897	283	.....	1911	8,200	7.75
1898	800	$17.50	1912	8,650	8.25
1899	1,400	20.50	1913	8,800	7.75
1900	2,900	14.00	1914	8,000	7.25
1901	650	7.50	1915	10,500	30.00
1902	650	7.50	1916	21,000	40.75
1903	1,300	8.75	1917	25,500	21.85
1904	4,200	15.00	1918	32,000	22.50
1905	5,800	13.50	1919	20,000	9.50
1906	4,350	10.25	1920	11,000	7.00
1907	6,100	13.50	1921	6,000 (a)	3.00
1908	4,500	10.25			

(a) Estimated.

TABLE II. ANALYSIS OF SCHEELITE AND WOLFRAMITE IN PER CENT

	Tungstic Acid, WO_3	Copper	Tin	Phorphorus	Sulphur	Manganese	Lime	Magnesia	Iron
Bolivian scheelite	63.79	0.03	Tr.	0.071	....	....	....	....	....
Argentine scheelite (a)	71.90	0.02	Tr.	0.079	....	....	....	....	....
Korean scheelite	66.56	0.27	1.68	0.068	....	0.24	....	....	....
Nevada scheelite	67.10	0.05	Tr.	0.036	....	....	....	....	....
California scheelite	63.72	....	....	0.020	0.80	....	....	....	....
Portuguese wolframite (b)	64.23	....	0.44—0.66	....	....	5.19	1.10	3.16	8.55
Bolivian wolframite	67.65	0.02	Tr.	0.014	....	0.94	....	....	....
Peruvian wolframite	65.81	0.02	0.48	.....	....	1.71	....	....	....
Argentine wolframite (c)	64.50	0.07	....	.....	Tr.	....	....	....	....
Chinese wolframite	67.26	....	0.79	0.037	0.15	5.74	0.61	....	....
Australian concentrates (d)	64.23	0.97	0.45	....	....	1.01	1.21	7.16	12.98
Western ferberite	65.80	....	....	0.040	0.09	0.15	0.30	Tr.	....

(a) Arsenic 0.06 per cent. (b) Silica 8; alumina 5.5 per cent. (c) Bismuth 1.5 per cent, (d) Silica 3.21; Alumina 2.31 per cent.

down, and importations from these countries during 1920 and 1921 represent to a large extent the shipment of unsold accumulations at the mines, as the ruling prices during the last two years have been insufficient to make commercially possible the mining of new ore. The production of China is now governing the world's markets.

The prices given in dollars, do not necessarily represent the dollar price actually paid, as the market in the United States for tungsten was limited, and the above prices represent the English or German quotation per English or metric ton unit converted into United States currency at normal exchange.

For the years of the war it is impossible to give a world's quotation. In Allied as well as enemy countries no free market existed; the prices were entirely controlled by government regulations. Therefore, the prices quoted in the United States in these years are given.

Peruvian Copper Mines To Be Developed By A. S. & R. Subsidiary

The Northern Peru Mining & Smelting Co., a subsidiary of the American Smelting & Refining Co., holds a three-year option, dating from April 16, 1921, on the Quiruvilca copper mines, and also has an option on the adjoining Almiranta copper deposits. In addition, it has a working agreement with respect to the Milluchaqui silver mines—the property of Vicente Gonzales Orbegoso, according to *Commerce Reports*. The Quiruvilca mines are about eighty miles east of Salaverry, in the Department of La Libertad, and fifty miles from Menocucho, the present terminus of the Trujillo Railway. They lie at an altitude of 12,000 ft. and can be reached by automobile and mule from Trujillo. The copper mines have been operated by the Quiruvilca Mining Co. for about ten years, producing about 2,000 tons of ore annually. The Milluchaqui mines are about halfway between Quiruvilca and Trujillo and produce a high-grade, siliceous silver-gold ore. There is a good vein of anthracite coal at Calluyacan, about five miles from Quiruvilca, which can be used for smelting purposes. Another vein of still better coal is found at Canibamba, which may be used as fuel for general purposes. The new company purposes to build a hydro-electric plant at Motil (twelve miles southwest of Quiruvilca) or at some other suitable point. This plant is to be capable of generating 2,000 hp. A smelter will also be erected if developments warrant such construction. If the Chuquicara branch of the Chimbote-Recuay line is extended as now planned it will run only 15 km. from this property. It is possible that the company will build a line to Trujillo.

Seventeen Plants Produced Potash Salts During 1921

More than 18,200 tons of crude potash salts, containing 7,618 tons of K_2O, were produced in the United States during 1921 from domestic sources, according to the Geological Survey. This potash was produced at seventeen plants, and about 79.5 per cent of it was extracted from natural brines. The total production from domestic material was less in 1921 than in any other year since 1915. Twenty-one plants made sales amounting to 8,907 tons of crude material, containing 3,895 tons of K_2O, valued at point of shipment at $383,218, and twenty-four plants reported stocks on hand amounting to 26,461 tons of crude material, containing 10,348 short tons of K_2O. The domestic potash produced in 1921 was made from natural brines, dusts from cement mills and blast furnaces, and wastes from molasses distilleries and from sugar refineries that employ the Steffens process. No production has been reported from alunite, silicate rocks, kelp, or wood ashes. The only plants that reported continuous operation during the year were several that produce potash from the dusts of cement mills and blast furnaces. The inactivity of the fertilizer market and the low price of foreign potash are given as reasons for non-production.

Mica Industry During 1921 Was Below Normal

Preliminary figures showing the quantity and value of mica sold in the United States during 1921, as reported by the Geological Survey, give a total of 3,854 tons, valued at $174,838. Of this quantity 371 tons, valued at $117,989, was sheet mica; the rest was scrap. These figures are obtained from reports received by the Survey from 97 per cent of those engaged in the business. The production was made by eight states: North Carolina, New Hampshire, Virginia, New Mexico, Georgia, South Dakota, Colorado, and Wisconsin, named in order of total value of mica sold from greatest to least. The total quantity of uncut sheet mica in 1921 shows a decrease of about 56 per cent, and the value a decrease of about 78 per cent; scrap mica showed decreases of about 39 per cent in quantity and of about 66 per cent in value, as compared with 1920. The most notable decrease is shown by North Carolina, where sales of uncut sheet mica dropped about 79 per cent in quantity and about 87 per cent in value in 1921, as compared with 1920. On the other hand, New Hampshire shows an increase in output of sheet mica of about 73 per cent in quantity, but a decrease of about 25 per cent in value. The increase in quantity is due to the larger production of mica of small size, such as punch and washer mica, which has had the effect of lowering the average price per pound of sheet mica in New Hampshire from 29c. in 1920 to 13c. in 1921. The average price per pound of all sheet mica sold in the United States in 1921 was 16c., as compared with 32c. in 1920, and the average value per ton of scrap mica fell from $29 in 1920 to $16 in 1921.

The consumption of mica in the United States depends largely on the available quantity of foreign mica, the importations of which showed a notable decrease. The cut mica and splittings imported for consumption—the splittings form the greater part of the imports—fell in value from $2,011,434 in 1920 to $758,521 in 1921. The unmanufactured mica, consisting essentially of uncut trimmed sheets, dropped in quantity from 1,298,537 lb. in 1920 to 328,444 lb. in 1921, and in value from $1,177,943 in 1920 to $331,219 in 1921.

A Correction

In the *Journal* of March 11 we published an article by Walter Stalder, "The Ciervo Anticlinal Bow Oil Field of California." The title as submitted by Mr. Stalder was "The Prospective Ciervo Anticlinal Bow Oil Field." In view of the fact that this district has not yet come in as an oil field, the latter title is to be preferred, and we desire to make the correction accordingly.

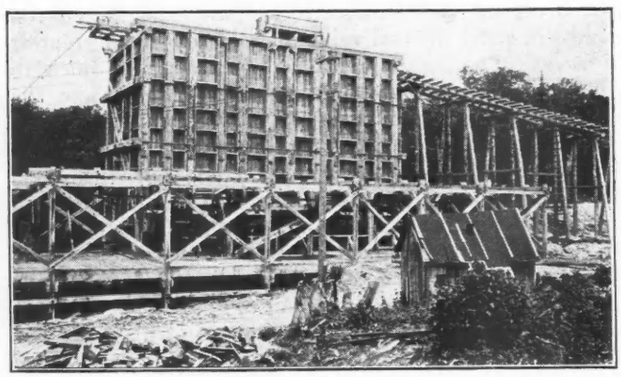
Asbestos Mining and Milling in Quebec—II

Modern Underground Mining Methods Now Being Introduced — No General Standardization of Milled Product—Simple Crushing, Screening and Suction Used To Separate and Grade Asbestos — Detailed Costs of the Various Operations

By Walter A. RuKeyser

THE SEARCH for crude asbestos and the operation of hand-cobbing begin immediately after the rock is block-holed. The first or rough cobbing rids the veins of asbestos of most of the adhering gangue. The final cobbing is done by girls, usually, in suitably designed sheds on the surface, and cleans the veins of any remaining rock particles and partially "opens" the asbestos. In one of the mines, the run-of-mine rock, with the refuse from the rough cobbing, is run over slowly moving conveyor belts for hand-picking. The product is sorted as to length and quality and bagged for shipment, the bags weighing 100 lb. net and the material running about 40 cu.ft. per ton of 2,000 lb.

After the sorting of the crude on the floor of the pit or benches, the rock which constitutes the mill feed is shoveled—usually by hand—into the boxes, or skips, of



Loading terminal for an aerial tramway

the cableways. It has been found impracticable to use mechanical means for loading these boxes, primarily because of the fact that a steam (or electric) shovel could not be kept busy enough—there being of necessity many working places, which may be on the benches of several levels. In the Thetford and Black Lake districts, at least, suitable grades for the egress of the shovels could not be maintained. In addition, there are the extremely irksome winter conditions, which would severely handicap movement of the shovel or loader. I know of no property in the district where a small loader or mucker such as is employed underground in metal mines has been used experimentally, although I think such a device might possibly find application under favorable conditions.

Cranes Effective in Handling Waste and Rock

Steam and electric cranes are used in two or three operations in the district to sort and handle the boxes of waste and mill rock. In this connection it must be remembered that the asbestos-bearing rock occurs in zones separated possibly by granite or, more often, by barren serpentine. This must all be mined. Thus a large proportion of "dead" rock results, usually about 25 per cent of the total and running as high as 40 to 60 per cent, which must be sent to the dump.

Usually both waste and mill feed are hoisted to the surface by means of cableways. However, at the Bell mine, a crane is used to load narrow-gage dump cars, and these are assembled into trains and hauled by means of a hoist through an inclined tunnel to the mill bins or waste-rock dump. This incline system has practically replaced the cable derricks. The lower third of this incline is situated in a pillar of rock left between two pits which are now connected by a main opening. The tunnel is about 1,200 ft. long and reaches the surface near the crusher house.

At Black Lake, the Black Lake Asbestos & Chrome Co. is using a crane to make up the trains of waste and mill rock on the floor of the company's main or No. 9 pit. Cableways are used to lower the boxes from the upper benches. This main pit is now connected by a 45-deg. raise to the floor of a smaller and more shallow working, Pit No. 6, and it is the intention to mill down from this pit, all of the rock being taken out through No. 9. A tunnel approximately 200 ft. long runs through the pillar, separating the two workings at the level of the tracks of the main pit. This is sufficiently large in cross-section to allow the crane to enter and to swing its boom when necessary to sort both classes of rock. Fifteen-ton steam locomotives run the trains to the wet-rock bin feeding the crushers and to the waste dump, both objectives being about 1,500 ft. from the face of the pit.

The topography of the Black Lake mine, coupled with the large amount of available surface area, has permitted the placing of the company's mill below the level of the pit floor.

Large Cableways Have Been Extensively Developed

Typical Thetford open-pit mining has probably been most highly developed at the King mine of the Asbestos Corporation of Canada, a reorganization of the old Amalgamated Asbestos Co. The operations at this mine disclose a high degree of progressiveness and show careful planning. The hydraulic stripping operations already described were begun by this company after an extensive diamond-drilling campaign, totaling 20,000 ft., that was awarded by contract to the Sudbury Diamond Drilling Co., which has had five drills in continuous operation since May, 1920. As much as 90 ft. of ⅞-in. core was recovered per day by one drill, and I am told that reserves of milling rock sufficient for thirty years' mill operation at the present rate of output have been blocked out.

The King mine, Lot 26, Range 5, Thetford, is the largest producer of the group, and the open pit has reached a depth of over 300 ft. At the surface it measures approximately 900 x 500 ft., and this width is increasing continually. Five powerful cable derricks now replace thirteen small ones by which the rock was formerly hoisted and conveyed to hoppers at the surface. These hoppers loaded into 36-in. gage cars, which were assembled into trains and hauled by steam locomotives to the bins or to the waste-rock dump, 4,000 ft.

distant. The five large cableways have enabled the mine to more than double its daily hoisting capacity, which must be approximately 3,000 tons in twenty-four hours at a maximum.

All the steam locomotives, both for the rock yard (which feeds the primary crushers) and for the dump, have been replaced by Canadian General Electric locomotives of the trolley type. The electrification involved one contract for equipment alone totaling over $110,000. It is said this step was taken primarily to eliminate the uncertainty of the coal supply, especially in winter, when railroad transportation from the United States may be seriously disrupted. However, a greater over-all efficiency and lowering of operating costs was probably the main reason for making the change, hydro-electric power being supplied to the mines of the district both by the Shawinigan Power Co. and the St. Francis Power Co., at rates averaging about $40 per horsepower-year on large new contracts. Fuel is now used only for the driers.

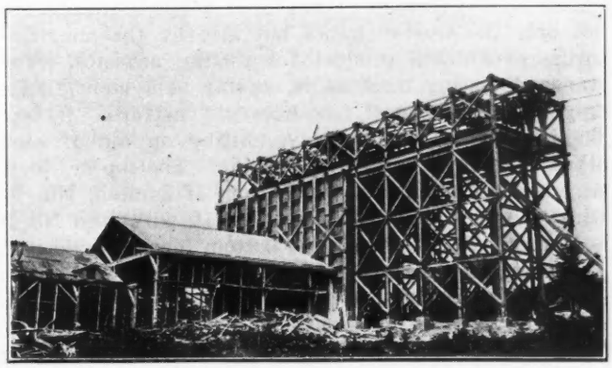
25,000-Ton Dry-Rock Bin

To facilitate continuous mill operation during the winter months, and to increase the flexibility of the system, a large concrete storage bin has been erected for the crushed and dried rock. The rock enters along a distributing conveyor from above and is drawn off to another conveyor through hand-operated arc gates at the bottom. This conveyor runs through a tunnel surrounded by "dead" ore. The sides of the bin are sloped at the angle of repose of the rock.

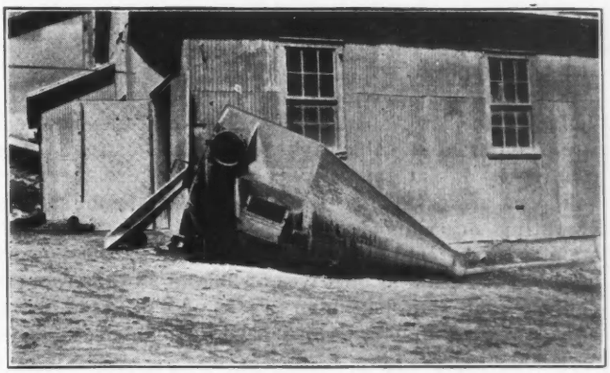
Although considerable underground exploratory work has been done in the district by several of the mines, only one property is really turning out its entire output by means of an underground mining system and shaft hoisting. This is the Thetford mine of the Consolidated Asbestos, Ltd., until 1920 the Jacobs Asbestos Mining Co. The property of this company consists of a long and comparatively narrow lot, surrounded by the workings of other companies. The open pit was about 225 ft. deep before underground mining was begun.

A triple-compartment shaft has been sunk to 515 ft. The first level was run at 188 ft., the main drift of which is 1,400 ft. long. From this main haulageway a series of crosscuts 75 ft. apart branched out, and raises were put up to the surface. The raises are vertical for the upper hundred feet or so, the lower parts being made into chutes inclined at 45 deg. From these chutes the glory holes discharge into the mine cars.

The haulage in the crosscuts is by means of horse-drawn steel cars. These are assembled in the main drift, where storage-battery locomotives take them to the loading pocket at the shaft station. The charging set for the locomotives is underground.



Discharge terminal for an aerial tramway



Collector used in many mills

A second level 175 ft. below the first has been driven, and by means of this the rock milled down from the former open pit is handled.

The shaft is vertical and timbered throughout, the headframe being of steel. The two skips are each of 2½-ton capacity and the hoisting plant has a capacity of 2,000 tons per day.

During 1920 a large loading pocket at the second level was completed and also a 160,000-gal. sump. The entire mine drains into this, drainage from the first level being effected through a series of 6-in. shot-drill holes. The cabled derricks are no longer used for hoisting rock, but only as accessories to fill the mine cars at the bottom of the pit for haulage through the first level. A part of the mine tonnage is hauled to the mill through a 20-deg. incline 1,015 ft. long from the surface to the bottom of the open pit. However, four-fifths of the total tonnage comes from the glory-hole operations and is shaft-hoisted. It is the intention eventually to use the incline only for a manway.

The rock after being hoisted to the surface is passed over a slow-moving picking belt for a further sorting out of the crude.

The "Combined" Method of Working as Practiced at Black Lake

The fact that the most productive asbestos-bearing ground rises steeply away from the railroad at Black Lake has permitted keeping the mine workings either at the level of the mill bins or above it. The topography thus lends itself to the driving of tunnels to the farthest-removed pits; or, as with the Asbestos Corporation's workings, has permitted the joining up of a scattered series of old workings by means of a main haulageway. These old pits were formerly under separate control, but, having been acquired by the corporation, are now consolidated into one extended system. The individual pits are being prepared for glory holing, and eventually the mine will be worked entirely by this method. A main haulageway, or tunnel, has been driven under the separate pits, thus connecting them underground. A branch tunnel has been driven to the south to a point under the Standard pit, a distance of 2,038 ft. At various points raises have been driven to the surface or to the bottom of old pits, so that the rock can be milled down for electric haulage to the mill in five-ton cars.

The rock is crushed by 36 x 42-in. jaw crusher to 5 in., being then further reduced to 2½ in. through three 15 x 20

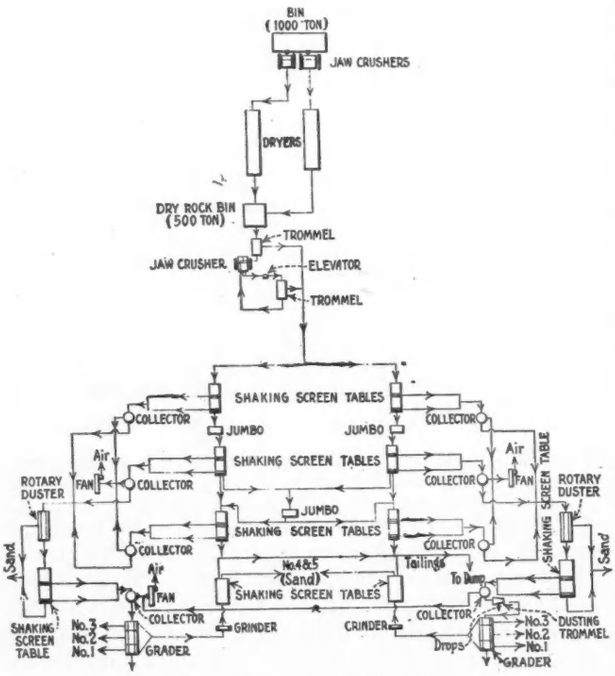
in. crushers of the same type. After drying, the rock is conveyed to a 25,000-ton bin similar to the one at the King mine.

The Canadian Johns-Manville Co., operating the Jeffrey mine, at Asbestos, near Danville, has now entirely eliminated cableways for rock hoisting. The country is of flat topography, and therefore the mine has been developed by means of four steam shovels operating on wide benches. The shovels load into standard-gage cars on the benches and in the bottom of the pit. Steam locomotives of 30 and 38 tons' weight haul the trains up maximum grades of 3 per cent to the mills, three in number, which have a combined capacity of 3,000 tons per day.

The problem at Danville differs from that at Thetford in that there is ample working space for the laying out of the grades and that the crude is more narrowly confined to high-grade zones.

Practically All Slip-Fiber Properties Worked By Steam Shovels

On the slip-fiber deposits steam shovels have found excellent application, owing to the fact that no crude has to be sorted before the rock goes to the mill. Thus, at East Broughton all the mines use this method, the



Typical flow sheet of a slip-fiber mill

shovels loading usually into 36-in. gage contractors' side-dump cars. The cars may be jogged back and forth between the working face and a crusher installation in the pit itself, as at the Quebec Asbestos Corporation mine, or hoisted out of the pit up an incline to the crusher bins, as at Asbestos Mines, Ltd., which has a 4,800-ft. aerial tramway of the Trenton-Bleichert type connecting the mine with the mill, having an hourly capacity of 50 tons. Its loading terminal bin has a rock capacity of 500 tons, the discharge bin holding 1,000. The loading terminal is 60 ft. above the discharge, and only 5 h.p. is required for the operation of the system.

At the Federal mine of the Consolidated Asbestos Co. the rock was formerly brought from the pit crushers to the surface on a 24-in. belt conveyor running through an 18 deg. inclined drift, but this method has been discontinued, and the cars are hoisted along an outside incline to the crushers installed on the surface. Much difficulty had been experienced with flooding and freezing, especially during spring thaws. The pit is about 300 ft. wide by 1,100 ft. long, and is worked in a single bench 125 to 150 ft. high. Both the foot and hanging walls dip at an angle of 67 deg. Two forty-ton shovels, both of the railroad type, supply the mill with its requirement of 1,000 tons per day.

Advantages of Caterpillar Shovel

At East Broughton the caterpillar shovel has been found most successful, being free from all track troubles and expense. One Harris shovel (Canadian made), usually with a 1¼-cu.yd. dipper, has been able to supply the mills from 600 to 1,000 tons per twenty hours. Hydro-electric power is used by nearly every mine in the district, and in almost every operation there is a direct railroad siding from the Quebec Central main line.

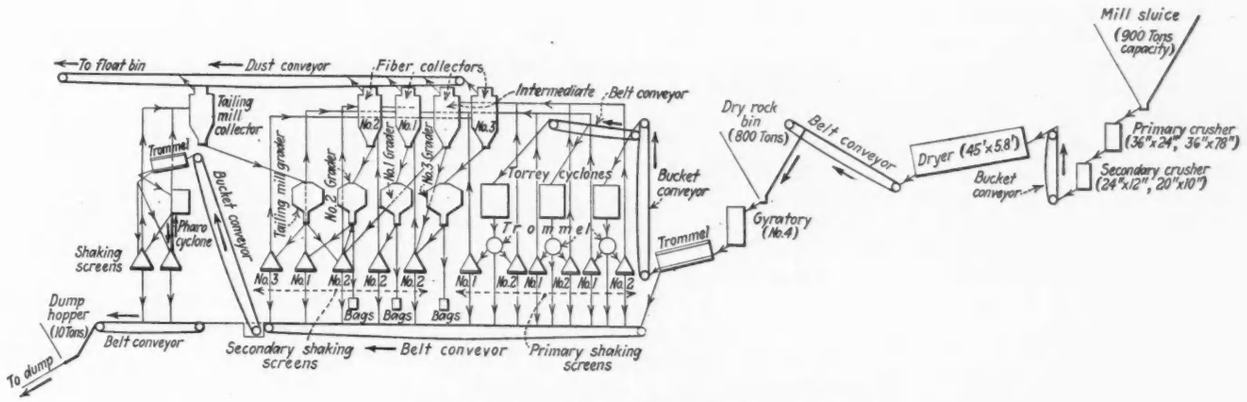
There is still considerable controversy in the district as to whether the advantages of underground mining systems outweigh the increased cost and disadvantages. The supporters of open-pit methods claim for their system that no skilled labor is required, no timber used, which some maintain contaminates the mill feed; no expensive shafts, stations, pockets and underground haulage must be driven and maintained, and a better separation of the crude is practicable. On the other hand, the supporters of underground methods maintain that twelve months' continuity of operations is possible in underground work; that a simplicity and centralization of hoisting is effected, eliminating signal boys and several hoistmen; that there is no waste of men's time in watching boxes overhead; and that a minimum of shoveling is necessary. However, in the Quebec district at least, the consensus of opinion is that open-pit methods are cheapest and best for shallow depths. The controversy starts only at that point.

No Standardization in Grading Milled Product

Before describing the milling methods practiced in the Quebec industry it is necessary to explain the complexity of the grading problem. The various companies have arbitrarily adopted specific grades and designations for their products, the crude alone approaching a state of standardization. But even the two grades of crude vary in price according to the percentage of the longer fiber in each, which is particularly true of the milled fibers. Thus there are more than fifty classifications of the mill products.

The following method has been adopted throughout not only the Quebec mines but also by the manufacturers of finished product for testing asbestos. The standard testing machine is, as far as I know, made only by the two local foundries at Thetford. It is a shaking screen of four trays, fitting on top of each other, the screens being 24 x 14 x 4 in. The top or No. 1 tray is fitted with a screen bottom of 2 mesh, No. 11 wire; No. 2 screen is 4 mesh, No. 17 wire, and No. 3 is 10 mesh, No. 18 wire. The bottom forms a solid pan. The nest of screens is fastened to a frame and given a horizontal throw of 1½ in. The shaft, fitted with an eccentric, is made to revolve at 300 r.p.m.

To make a test, one pound (16 oz.) of fiber is placed on the top screen and run for exactly two minutes. The fiber retained on each screen is weighed separately.



Typical flow sheet of a cross-fiber mill

and the number of ounces from each tray read in succession, the total, of course, adding up to make 16 oz. Thus, for example, if a sample of asbestos yielded a test reading 0-8-5-3, that grading would signify that 0 oz. had been retained on the top or 2 mesh screen, 8 oz. on the 4 mesh, 5 oz. on the 10, and the "drops" (or "pan"), that is, the minus 10-mesh screen, had reserved 3 oz.

The following table shows the average test of milled products for various purposes:

ASBESTOS TESTS

Purpose	Thetford	Black Lake	East Broughton	Peak Price per Ton
Long spinning fiber	1½–9½–4½–1	3½–8½–2½–1½	1½–9–4½–1	$800
Medium spinning fiber	0–8–6–2	0–8–6–2	0–8–6–2	350
Magnesia pipe covering and compressed sheet	.....	0–7–5–4	0–5–8–3	200
Shingle stocks	0–1½–9½–5 0–0–11–5	0–4–8–4 0–3–9–4	0–1½–9½–5	125
Paper and millboard	0–0–10–6	.....	0–0–11–5 0–0–10–6	80
Cement and roofing	0–0–5–11	.....	0–0–5–11	40
"Sands," either of dark pulpy nature; short clean fiber or sandy. (For cement and flooring.)	(a)	(a)	(a)	.....

(a) No test.

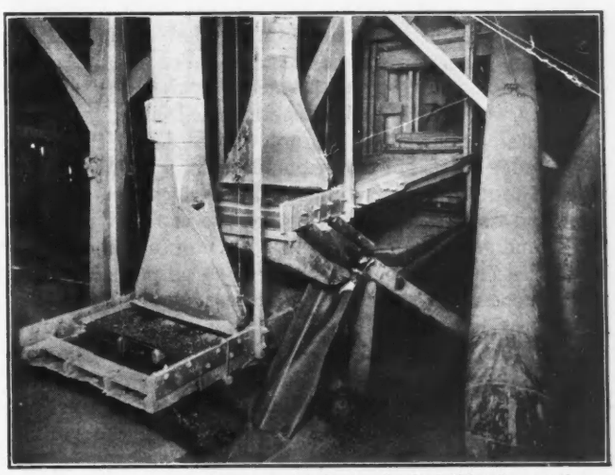
The problem of milling consists not only in recovering as much of the fiber from the rock as possible, but also with as great an average fiber length as is consistent with economy. Owing to the great difference in market price between the better mill grades and the poorer in general, the processes which have been evolved attempt to remove the fiber from the rock as early as possible during the treatment. Types of machines have been developed or applied with every attempt to spare the fiber from unnecessarily rough treatment, yet at the same time sufficiently breaking the rock which incloses it.

Crushing in Stages by Straight Impact

Concentration of asbestos by milling consists broadly in coarse crushing, drying, recrushing in stages, each step being followed by screening, during which air suction effects the separation of the fiber from the rock gangue; collection of the fiber, cleaning of adhering dust and rock particles by rescreening, grading, and, finally, bagging for shipment. This typical process is much the same today as when established in 1889 by Earle C. Bacon for the Scottish-Canadian Asbestos Co. (now defunct). The changes that have been made are essentially those of arrangement of the units in the flow sheet and of mechanical detail. The non-technical operator has always inclined in that district toward a *laissez-faire* attitude. Finally, it must be pointed out that the question of milling efficiency, per cent of recovery, and the like are largely indeterminate problems. Exact chemical determination of mill feed and tailings is not possible. There is no means of accurate analysis to check the results of the mill run. The matter has resolved itself to the present time in weighing the rock going to the mill and the production of fiber resulting. It is because of this last fact that modifications of practice throughout the district are the dictates of individual taste or judgment rather than conclusions based on accurate comparative data.

As the asbestos is deposited along lines of weakness in the rock, it follows that breaking by straight impact would be the ideal condition. The "squeeze" of the primary jaw or gyratory crusher is thus not harmful to the fiber, and the problem becomes of importance only in the later reduction. So it is that coarse crushers reduce the rock as much as possible, and the fiber liberated during this stage is separated from the rock before treatment by fine crushers.

In a typical milling operation, rock from the mine is dumped into a hopper or bin which feeds the primary crushers. Too often, the bin is of limited capacity, and any delay at the working face is reflected in mill operations. It must not be forgotten, however, that storage of wet serpentine is extremely difficult, if not impossible, under the Quebec winter conditions. For example, in January, 1920, the temperature at no time went above zero, and often hovered for days at 10 to 20 deg. below, reaching a minimum temperature of —48 deg. F. As



Courtesy of Asbestos, Crude & Fibre Corporation.

Shaking screen tables

soon as the run-of-mine rock hit the plates of an unheated bin, the entire mass would freeze solid. Only by continual barring down, bulldozing with powder, and by never allowing the flow of the rock to cease could the bins be kept open. The frozen fines in particular would tend to form a cementing medium binding the large blocks. Under such conditions operators have considered it advisable to provide large dry-rock storage wherever feasible, and in an extreme instance (the Asbestos Corporation) 25,000 tons' storage has been provided. This is sufficient for a fortnight run of the mill.

Primary Crushing Usually by Jaw Type Machines

Coarse breaking is usually done by jaw crushers, because the better-sized product of the gyratory type machines is not a distinct advantage. The two primary machines at the King mine are 72 x 32-in. Blake type jaw crushers of a capacity of 100 tons per hour. At the Johns-Manville Co.'s mine the jaws of the primary crusher have an opening of 60 x 84 in. to take steam-shovel material direct. This is a Traylor crusher 19 ft. 7½ in. long, 11 ft. high, and 18 ft. 1½ in. wide, weighs 500,000 lb. and delivers 3,000 tons per eight-hour day of 10-in. product. Owing to the slippery nature of the serpentine, it was necessary to have an acute angle of nip—viz., 18 deg.

From the coarse crushers, of which there may be two, or even as many as three, series, possibly of jaw and gyratories combined, the rock is conveyed or elevated to the drier. Drying is an extremely important operation, the milling efficacy largely depending upon how well this is done. Too little drying hinders recovery and fiberization; too much injures the fiber. Hence, earlier operators used the indirect heat type of drier; for in that way it was thought that danger of "scorching" (partly dehydrating) the fiber was eliminated. The direct-heat drier, with its greater thermal efficiency, is now used almost everywhere; and one or two mines even employ the combined direct and indirect heat type in which the hottest gases pass around the shell of the drier and the last amount of heat is given up to the rock during the return of the gases of combustion through the shell. Although standard Vulcan, Ruggles-Cole and American Process driers are to be found, it is more usual in the district for shells to be made up by some Canadian foundry, and the castings and drives are purchased or made locally.

With the exception of the practice of the Asbestos Corporation, the horizontal rotary-shell drier, with a firebox at one end and a dust chamber at the other, is generally used. The speed at which the shell is revolved, its length and diameter, inclination from the horizontal, and whether or not a forced draft is to be used under the firebox are considerations which must be worked out for each individual application, depending upon the rock to be dried and the capacity required. The same factors determine whether or not there shall be baffles and whether the rock is to be passed concurrent or countercurrent to the gases of combustion. The Asbestos Corporation uses the stationary, vertical-tower drier patterned after the Edison type, in which the rock is dropped from the top and encounters a series of crossed-rod baffles in its downward passage against the uprising gases. From the drier discharge the rock is usually conveyed to dry-rock bins, where storage for at least two days' mill run is usual.

It is considered best practice to begin taking off the fiber immediately. The dried rock is therefore passed through trommels, and the fines, containing the liberated asbestos, are passed over shaking-screen tables. These may be 6 ft. in width by as much as 20 ft. long, and may consist of one, two or three decks covered with suitable screening, and shaken by means of an eccentric at, say, 300 r.p.m. Suction hoods made by the mill's tinsmith are suspended at the discharge end of the tables or of each plateau of the table. The hood runs the width of the screen and has an opening of about 4 in. It is connected by means of piping to conical-bottomed collectors, and the entire system is put under suction. Formerly, the material was made to pass directly through high-speed suction fans, this resulting in a needless tearing of the fiber. The shaking tables are not primarily for screening purposes. They rather serve as a means by which the feed can be spread out sufficiently for the suction to separate the asbestos from the heavier rock particles, and their oscillatory motion results in a "bedding" of the material. The particles which pass through the screen cloth (usually of from 8 to 12 mesh) are barren of commercial fiber and go to waste.

The regulation of the screening and suction affords one of the most interesting fields for experimentation in asbestos milling. I have never seen any record of accurate data showing the results of varying the inclination, the dimensions, the rate of vibration of the tables, nor the relation of rate of feed to them with a variation in the suction. Roughly speaking, the table as used in the average installation must have a capacity of twenty tons an hour, treating rock of average fiber content, and when a moderate suction (8 in. of water) is applied at the hoods.

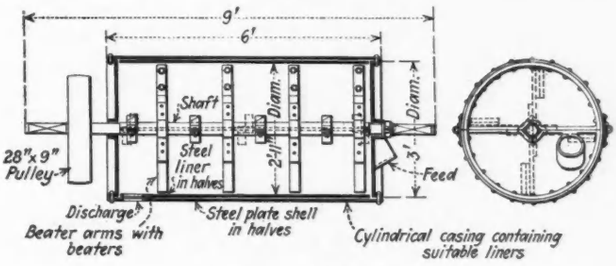
Final Crushing Either by "Cyclones" or "Jumbos"

The secondary crusher may be in closed circuit with a rotary screen or trommel, the undersize from which goes to a second screen table. A further separation of fiber is effected in the same manner as before noted. The oversize is then passed to fine crushers, machines which have been specially developed in this district for asbestos milling, the older "Cyclone" and the recently more popular "Jumbo." Rolls have been tried and are occasionally used, but, owing to the matting of the resultant discharge, they have not found great favor in the asbestos mill. These machines are particularly inefficient on the talcose rock of the slip-fiber deposits.

As pointed out, the desired effect in the reduction of the asbestos-bearing rock is one of straight impact and disintegration permitting the freeing of the fiber and at the same time "fluffing" it. A minimum of grinding or shear action is desired. With this in mind the Laurie "Cyclone" was first evolved, with later modifications by Pharo at the Beaver mine and Torrey at Black Lake. The "Cyclone" consists essentially of two cast-steel impellers shaped like a ship's screw, weighing approximately 1,000 lb. each and made to revolve at a high speed (2,000-2,200 r.p.m.) in an inclosed chamber lined with manganese-steel plates to withstand the impact of the rock hurled against it. If a lesser action is desired the impellers may be made to revolve in the same direction, but in the usual practice they are rotated in opposite direction to each other. It is claimed by many that the "Cyclone" produces a great amount of attrition, injuring the fiber; is of low capacity, wasteful of power, and necessitates frequent and costly repairs.

The impellers must often be changed every two days, owing to the high speed at which they are revolved, and must be balanced on their shafts with extreme care.

The above considerations led to the development of the "Jumbo," a machine, better mechanically, which has for some time replaced the "Cyclone" on the Broughton rock. Within the past two years much experimentation has been done using the "Jumbo" on the harder Thetford and Black Lake rocks, and the machine is finding



Sketch of "Jumbo"

a great deal of favor with some operators who have discarded the "Cyclone." The "Jumbo" is really a modification of the ordinary pulverizer, consisting primarily of a horizontal shaft fitted with a series of arms, these in turn carrying "beaters." The whole is caused to revolve at from 400 to 800 r.p.m. (as the nature of the rock dictates) in a cylindrical casing lined with suitable plates. The rock, fed from above at one end, is made to pass through the machine by a deflection of the beaters, and drops out at the other end. Here again is a great field for scientific test-work, as a variation in the speed, the length, number, spacing and type of beaters causes a great difference in the results obtained by the machine.

Fiber Is Carried by Suction to Collectors

From the succession of "Jumbos," "Cyclones," or combinations of both, the crushed serpentine and asbestos is spread over respective screen tables and the fiber again lifted from the rock gangue by suction. This is done as many times as necessary to effect the limit of economical separation from the rock. All the fiber is sent to collectors, which usually consist of galvanized sheet iron forming cylinders 6 ft. in diameter by 6 or 7 ft. high, terminated at the bottom by a truncated cone with a height also of 6 or 7 ft. These collectors are fitted with suitable baffles, which prevent the fiber from being exhausted into the atmosphere and thus lost.

From the collectors the fiber drops to a series of rotary or shaking-table screens, where all adhering dust and rock particles are removed from it. After this cleaning it passes through the graders. These consist of hexagonal or octagonal screens, which are slowly revolved, sometimes with a bumping motion, about a shaft which is slightly inclined to the horizontal. The graders are divided into sections fitted with screens closely approximating those used on the standard testing machine already described. The products from the graders go to their respective bins and are bagged in 100-lb. lots, either by hand or by semi-mechanical devices.

Waste serpentine is sent to a dump over belt conveyors, or, where this is not possible, by trams. Many of the dumps now contain three to five million tons.

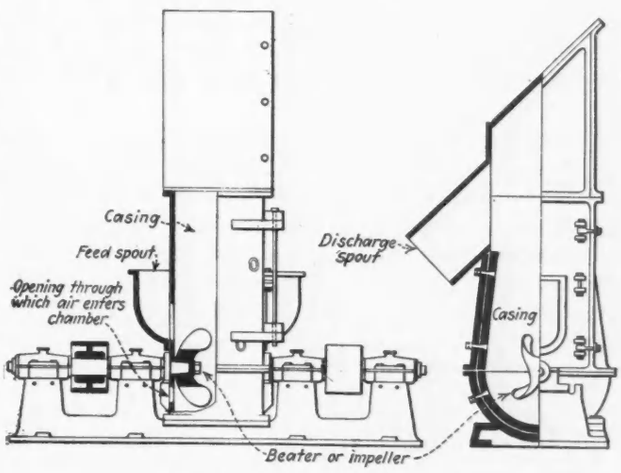
The accompanying flow sheets are typical, the one of cross-fiber milling at Thetford, the other of slip-fiber practice at Broughton.

One large mill in the district recently attempted to replace both "Cyclones" and "Jumbos" by reduction-type gyratory crushers breaking to about 1 in. However, the results could not have been successful, for the "Cyclones" have been put back into the flow sheet. Another plant at Black Lake has installed a swing-hammer mill manufactured by the K-B Pulverizer Co., with extremely satisfactory results. I understand that one of these machines is doing the work of three "Cyclones," with a great saving in repairs and power. The same plant has been experimenting with a new type of stationary screen, which requires no power and no replacement of any screen surface. This, too, has proved successful, and is based upon an entirely new principle.

The Asbestos Corporation has recently been running an extensive series of tests with the Mitchell vibrating screen, and one of these screens has likewise been installed by the Quebec Asbestos Corporation at East Broughton. To avoid duplification of data and to obtain comparative results, the Asbestos Mines, Ltd., installed a Tyler Hum-mer electric screen. It is still too early to state definite conclusions, but these machines will probably have their best, if not their only, application in the secondary process of cleaning the fiber and possibly in grading. For this purpose, tests so far made indicate that the vibrating screen, at least, has a capacity four or five times greater than the old shaking screen table.

Department of Mines at Ottawa Doing Extensive Testing

I have had the privilege for the last several months of consulting with the Department of Mines at Ottawa on some extensive asbestos milling test work which is being conducted under the direction of W. B. Timm. Several possible, and in some cases radically different, courses of action were laid out. The first involved dry milling, breaking as far as possible, say, to 1 in., in the jaw crushers; then sending the product to Hardinge



Sketch of Laurie "Cyclone"

mills. It was found that by applying suction direct to the mill the asbestos might be separated and removed without undue attrition. Mr. Timm has just completed a comprehensive and scientifically prepared report on this first test, but this is not yet generally available. The conical pebble mill has already been used in the district for regrinding the tailings for the preparation of a special product used for plaster and cement purposes.

Another interesting possibility in asbestos milling is by application of wet-grinding methods, even wet concentration by tables or flotation. The advantages, elimination of the dust evil, drying required only for the product, and not for the entire mill-feed; lesser cost of grinding, and protective action on the fiber, might prove so important in any successful method that they could easily revolutionize this phase of the industry.

It is the intention of the Department of Mines, Canada, to publish the results of all this work as soon as completed.

Six to Seven Per Cent Average Extraction for the District

Statistics prepared by the Department of Mines of Quebec show that before the Great War the value of the rock in the ground was below $1.50 per ton; recently it has been $4 per ton or over. The per cent of fiber extraction has averaged between 6 and 7. The average value per ton of the product increased from $35.90 in 1910 to $81.89 in 1920. The percentage of No. 1 crude decreased consistently from about 0.1 per cent in 1910 to about 0.033 per cent in 1920. That is, to obtain the same amount of crude, three times as much rock has had to be mined and hoisted. Thus, the 3,000,000 tons resulted in twice as much crude No. 2 and practically three times as much mill product. This shows that the rock mined in 1920 is not nearly as good as that handled in 1910, and that the mills therefore must have made considerable increase in recovery to maintain the proportion of mill stock. Rock mined was about 20 per cent greater than that milled in 1910; about 16 per cent in 1920. This average includes figures from East Broughton, where all the rock mined is milled. In 1920 there were reports of shipments by seventeen companies operating twenty-one mines. Prospecting and develoment was being conducted by nine other properties.

Costs

The following represent average results from an 800-ton per day mill working on slip-fiber rock mined by steam shovels from a pit 150 ft. deep. The figures are for the year 1919:

Value of ore milled, per ton	$2.60
Total expenses per ton mined and milled	$1.65
Recovery of fiber, excluding "asbestic" per cent	4.81
Average selling price of fiber, per ton	$60.00
Average operating expense (only), per ton	$38.00

The operating expenses include mining, milling, cost of bags and bagging, shipping, power and mine office charges, but not head office, sales, and other overhead. A typical report on cross-fiber operations gives the following:

Total tons mined (March, 1921), per shift	1,001
Rock to mill, per cent	65.5
Drier coal used per day, tons	10.470
Average cable-derricks used	9.6
Average payroll, per shift:	
Miscellaneous employees	13
Transportation	11
Teams	16
Machine shop and repairs	17
Mill, bagging and loading	37
Mining	108
Sorting crane	21
Total men	223

The figures show a production of about 4.5 tons per man for every man on the work and about 8⅛ tons for every man in the mine.

The cost per ton delivered to mill or rock dump for derrick mining averages $1.017; the cost per ton, by crane handling, $0.576, and by crane and derrick, $0.850.

Underground development work produced rock at $1.895 per ton in crosscutting and $2.080 in tunneling. The total cost is proportioned as follows:

	Per cent.
Labor, mining	72.5
Supplies, mining	13.7
Labor, transportation	4.4
Supplies, transportation	2.5
Power	2.9
Insurance and miscellaneous	4.0
	100.0

At East Broughton, mining by steam shovel and milling is being done for $0.80 a ton.

At Black Lake a typical daily average might be expressed by the following:

Value fiber per ton of rock mined	$2.51
Value crude and fiber per ton mined	$3.43
Total operating and mine expenses per ton rock mined and milled	$1.48
Average value fiber per ton	$329.75
Expenses (mine) per ton fiber	$147.24

The cost of milling, bagging, loading, and mine overhead thus is about 45 to 50c. per ton milled and correspondingly less per ton mined. The above costs are for March, 1921, when operating conditions were perhaps at their worst and wages and supplies at the peak.

Exploration and Construction Costs

Diamond drilling in 1921 was contracted for at from $3 to $3.75 per ft., the latter being for a 1,000-ft. contract with 1¼-in. core recovery. Counting seven set-ups, the work averaged 25 ft. per day of twenty hours, all the holes being inclined. A maximum of 91 ft. was made in one day. The crew consisted of two runners at $6 per ten hours, two helpers at $4.50, and a foreman at $300 per month. Five and one-half carats of carbons were used.

Calyx shot drilling for a 4¾-in. hole averaged $0.94 per ft. on a 212-ft. hole inclined 15 deg. from the vertical. The average progress was 11 ft. 1 in. per shift. The average cost for seven holes, all inclined, totaling 1,426 ft., was $1.28 per ft. in 1919, including all moves, and $1.15 per ft. excluding moving. Twelve shot-bits were used, at an average cost of $0.0791 per ft.

Exploratory drifting in serpentine can be done as cheaply as $6 per ft.; shafts down to 150 ft. about $15 per ft., with stull timbering only. Permanent work of large cross-section requires timbering.

Approximate Cost of an 800-Ton Per Day Plant

The following is a recapitulation of the estimated cost of replacement of a complete plant to handle 800 tons per twenty hours for steam-shovel mining the slip-fiber deposits:

Construction	$85,000
Tramways and railroad	5,000
Machinery (complete)	135,000
Machine foundations	4,000
Motors	45,000
Chutes and spouting	1,500
Auxiliary cableway	10,000
Locomotives and cars	12,000
Steam shovels	60,000
Shafting, pulleys, belting	15,000
Steam, water and air pipe	7,000
Dust collector system	11,000
Lighting and power wiring	12,000
Office equipment	1,500
Teams, stable equipment	2,000
Tools and miscellaneous	10,000
Total	$326,000

This is at the rate of a trifle over $400 per ton daily capacity. Of this total amount, the mill and contents represents approximately $95,000, the driers, $22,000, the bins, $21,000 and the crushers, $21,000.

A 4,800-ft. Trenton-Bleichert fifty-ton per hour aërial tramway with two large bins, complete, installed, cost less than $50,000 at peak prices.

In 1920, general pit labor cost from 35c. to 42½c. per hour, against 17½c. in 1915 and 12½c. in 1914. Mill and drier men received from 37½c. to 45c. per hour, and steam-shovel runners up to 55c. at the peak. Carpenters, blacksmiths, and the like commanded 45c. and 50c. An average wage of about 42½c. was the prevailing rate for all classes of labor in 1920.

In mentioning this phase of the subject it is necessary to point out that a condition exists in this district different possibly from that in any other in the world and comparable in a way only to Mexico. Unions, in the ordinary sense of the word, do not exist. The men are practically all French-Canadians, and, except in unusual instances, do not speak or understand English. The bringing in of skilled imported or foreign labor creates hostile feeling. The available resident help is for the most part unskilled men who leave the mines to farm in the spring and harvest, and who possibly leave for the "bush" to cut lumber or pulp wood in the winter.

The Church is necessarily all-powerful in the district, the local curé acting as labor leader, moral advisor, and mentor in general. Any attempt upon the part of the mine managements to vest in themselves these powers, in whole or in part, is not encouraged. In one or two instances which have come under my personal attention the village priest has asked that the company abolish a proposed plan of outside education and amusement. The men are extremely wary of any innovation, and to establish even such a benefit as group insurance, the curé was called upon to give his sanction and explain the move to the men. Often, high Church dignitaries visit the respective mines, establish shrines in the workings, and invoke the blessing of God on the operation.

The men are for the most part loyal, although committed to everything that is usual and customary to them. It is therefore extremely difficult to introduce new methods. It is usual for the lesser executives to be mustered from the French-Canadians, but the operating heads are almost without exception English, Canadian, or American. During the war many of the men enrolled under the American flag.

The individual nearly always owns his own home and farm; there is practically no floating population. These homes are nearly always scrupulously clean. The schools and hospitals are under the direction of the Church. The extensive size of the average family prevents any tendency toward a Red philosophy, and the men are consistent, if not too efficient, workers. Owing to the great number of religious and state holidays, and the all prevailing "high-wine" (a white whiskey with a 150 per cent "kick"), 250 working days is a high average for the year.

Great Progress Made With "Safety-First" Work

The above-stated facts have, of course, not affected the attempts of the various mine managements to promote the safety and welfare of the men wherever possible. The shaft and tunnel for the circulation of the men at the King mine is an example of this progressive attitude. All mines and mills take the usual, and in many instances unusual, precautions to promote safety. Thus, the Johns-Manville Co. has procured the services of an efficiency and safety engineer. Meetings are held and lectures on "Safety First" given. The company has organized a hospital in charge of a trained staff.

A further example of welfare work is the building of thirty-five modern cottages during the summer of 1920 by the Bennet-Martin Co. at the company's Vimy Ridge mine. This property is about six miles off the main line of the railway and has established a thoroughly up-to-date community. I understand that twenty-five more cottages were built during the past year. The houses, which are of extremely neat appearance, have a concrete foundation, and are of frame construction, with double sheathing, a layer of building paper covered over by asbestos board, and are roofed with asbestos shingles.

Many of the mines have well-run boarding houses, and all-in-all there is a well-established feeling of contentment among the labor of the district.

It has been the purpose of this article to show that the present technology of the Quebec asbestos deposits is the direct result of their geology coupled with a former lack of capital in the hands of small, individual owners who were themselves the operating heads. The modern and future tendency is constantly being based upon refinements of technique.

More especially in the milling department will there be a tendency toward the evolution of radically new methods, for the present state of the industry bespeaks possession of the means for experimentation and costly test work. The mining methods, although to a large degree dependent upon factors which permit of no change, will possibly in the future be laid out upon a more extensive scale, resulting from the further amalgamation of companies. Finally, there is being attracted yearly to the district a type of highly trained technical operator who is sure to effect the adoptation of the principles of best practice from outside fields.

Spanish Metallurgical Situation in 1921

Mining reviews and the technical press generally agree that 1921 was a year of crisis for the Spanish metallurgical industries. Although all industries in the kingdom felt the effects of the world-wide depression, mining and metallurgy suffered the most severely, according to Charles H. Cunningham, commercial attaché at Madrid. This crisis is a part of the inevitable readjustment following the enormous increase in prices of the preceding years. Producers faced the necessity of lowering costs to stimulate the market for their output, demand having fallen off sharply as a result of the high prices asked; but labor troubles and employees' requests for higher wages prevented the reduction of production costs, and losses to the producers followed, resulting in the closing down of many mines.

Toward the end of 1921 the situation improved somewhat, and several of the plants have reopened. One Spanish journal, in reviewing the year, says:

"The coal and iron industries have suffered most in Spain, as they have in other countries, being interdependent and having many other industries contingent upon them also. Furthermore, there have been serious crises in the lead, copper, and zinc industries.

"Lead mining also has passed through a crisis. In Linares, La Carolina, Cordoba, and Cartagena many of the workers have been discharged and only the more important industries have been exploited, and these with little profit. Prices for both ore and metal declined, particularly during April, May, and June, but by the end of 1921 quotations were again in the neighborhood of those with which the year started, being different from coal and iron in this respect.

"The exportation of pyrites from Huelva has also been paralyzed and the number of workers cut down considerably. Exports (in metric tons of 2,204.6 lb.) of copper ore containing less than 2½ per cent of copper during the first ten months of 1920 and 1921 amounted to 236,223 tons and 193,714 tons respectively."

Mineral Sulphides As a Source of Electric Energy

Laboratory Experiments Show That a Cell of the Bunsen Type Can Be Used With Pyrite as an Anode in an Alkaline Solution—Possibilities of Economy Over Existing Methods of Generating Power Suggested

By G. N. Libby

THAT MINERAL SULPHIDES may function both as attackable and unattackable electrodes in electrolytic cells has been demonstrated by a number of investigators, the work of R. C. Wells, as discussed in Bulletin No. 240 of the U. S. Geological Survey, being especially noteworthy. To show further that they may be a source of electric energy of commercial value, and to stimulate interest in the solution of the chemico-mechanical problem, is the object of this paper.

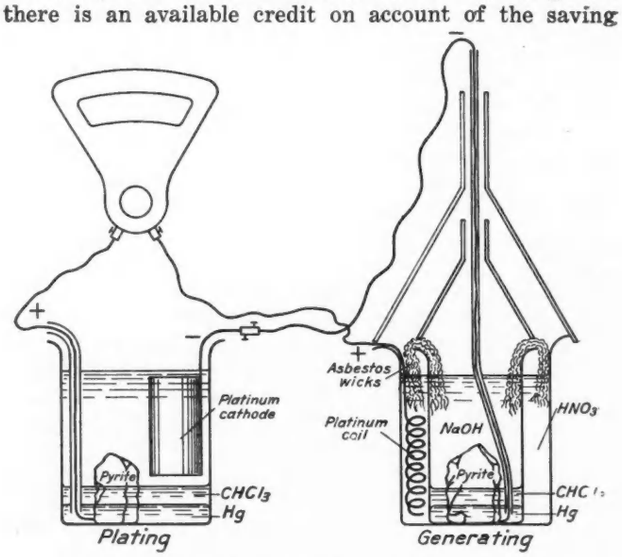
COMPARATIVE HEATS OF OXIDATION

Substance	Product	Components	Calories—Total	Calories—Per kg.	Kw-hr. per kg. = Electrical Equivalent kg-cal / 863
C	CO	C+O	29.3	2440	2.83
C	CO_2	CO+O*	73.9	6160	7.14
C	CO_2	C+O_2	103.2	8600	9.55
S	SO_2	S+O_2	77.6	2420	2.80
S	SO_3	SO_2+O	71.7	2240	2.60
S	SO_3	S+O_3	141.1	4410	5.10
Fe	$Fe(OH)_2$	Fe+O+H_2O	68.9	1210	1.41
FeS	$FeSO_4$	FeS+O_4	210.9	2390	2.77
FeS_2	$FeSO_4H_2SO_4$	FeS_2+O_7+H_2O	352.0	2930	3.40
Zn	$Zn(OH)_2$	Zn+O+H_2O	83.5	1273	1.48
ZnS	$ZnSO_4$	ZnS+O_4	205.0	2345	2.73
Pb	PbO	Pb+O	30.8	244	0.28
PbS	$PbSO_4$	PbS+O_4	195.0	815	0.945

In the accompanying table are tabulated the heats of oxidation of carbon, sulphur, the commoner mineral sulphides, and their metals. It will be noted that, weight for weight at maximum oxidation, sulphur has about half the value of carbon and that the electrical equivalent of this heat is 5.1 kw.-hr. per kilogram of sulphur. Unfortunately, sulphur is such a poor conductor of electricity that its use as an attackable electrode does not seem encouraging. However, in combination with the common metals, lead, copper, and iron, it exists in the form of mineral sulphides, which are fairly good conductors, and which, as will be shown, may function as readily oxidizable electrodes liberating energy chiefly as electricity. Among these mineral sulphides galena is by far the best conductor, but, owing to its high molecular weight, equal amounts develop only about one-fourth the energy value of pyrite, which in turn is equal to about one-third its weight of carbon.

Carbon burned under boilers can yield only about one-third of its energy in the form of electricity, so that it is patent that pyrite and carbon are theoretically equivalent for power purposes if the heat of oxidation of pyrite can be changed directly into electrical energy, and practically so if the cost of conversion is the same. The power-house cost of changing the heat energy of coal into electricity is well known. No data are available upon which to base the cost of operating electrolytic cells of the type and size that the problem demands. However, it is known that, for instance, in the cyanide process, where large tonnages of ore are treated, the cost for agitation, filtration, handling, and so on, which are the prime factors in electrolytic-cell operation, is almost unbelievably small, being at the Homestake mine about 70c. per ton. Possibly the most important point to be considered is the fact that quantities of copper pyrite are daily oxidized in metallurgical plants, resulting for the most part only in the discharge of sulphurous gases into the air, which, owing to the possibility of producing damage, have been the cause of costly litigation.

The cost for oxidation by roasting could be credited to any system that would produce equivalent results in recovering the metal from the ore. With pyrite, then, it is not so much a question of comparing it with coal, for here we have a substance that is essentially a waste product, which is already mined and delivered, and which must be oxidized. In doing this there is an available credit on account of the saving



Electrolytic cell showing pyrite as anode

in treatment. Normally in the Butte district, Montana, about 4,000 tons of copper pyrite is oxidized daily in the production of copper. The energy capable of being generated by this pyrite, if there were no loss, is equal to

$$3{,}490 \times 4{,}000 = 13{,}960{,}000 \text{ kw.-hr.}$$

or

$$\frac{13{,}900{,}000}{24} = 580{,}000 \text{ continuous kw.}$$

This is worth, if we compare it with the best coal-burning practice,

$$580{,}000 \times \$20 = \$11{,}600{,}000 \text{ per year}$$

or

$$\frac{11{,}600{,}000}{365} = \$31{,}600 \text{ per day}$$

or

$$\frac{31{,}600}{4{,}000} = \$7.90 \text{ per ton of copper pyrite.}$$

The proportion of this value that would be realized would, of course, depend on cell efficiency, which might be anywhere from 50 to 90 per cent. Of course, just as coal cannot compete with water-power as a source of electricity when cheap development is available, even

if the coal is obtained for nothing, so one can never hope to compete with it by cell-oxidation of sulphides; but it will be noted that owners of water-power value their electrical energy not by what it costs them but by its value in competition with coal.

Model Laboratory Cell Developed

Seeing, then, that there appeared to be some economic hope for a cell in which mineral sulphide could be oxidized, it was warrantable to attempt the construction of a laboratory model. After a number of preliminary experiments it was noted that these sulphides oxidized rapidly in an alkaline solution; acting, in fact, as zinc would do in the same solution, but with a lower electromotive force. Perhaps nitric acid is the most efficient depolarizing liquid known, producing, by the cell action, nitrogen dioxide (NO_2), which is readily oxidized again to nitric acid; so that, theoretically at least, by proper oxidation and absorption of the gases from a cell of the Bunsen type, nearly all the acid can be recovered and used again, the atmospheric oxygen being the only substance consumed.

A modification of a cell of this type, shown to the right of the sketch, is easily assembled. In a tall 300-c.c. beaker was placed a smaller 200-c.c. beaker. Into the small inner beaker enough mercury was poured to cover the bottom to a depth of about ¼ in. An insulating layer of chloroform of about the same depth was then added. The small piece of pyrite, about 1-in. cube, placed in the beaker made good electrical contact to the chloroform-covered mercury. A strong solution of alkali was then poured in till it nearly filled the beaker. Strong nitric acid was added to the outer beaker to the same height as the alkaline solution, and the two solutions were connected by about thirty ¼-in. asbestos wicks. A platinum wire served as the acid electrode, but carbon, iron, or aluminum might have been used. A copper wire protected by a glass tube and inserted into the mercury gave an electrical connection to the pyrite. The cell as constructed consisted of platinum, nitric acid, a diaphragm, caustic soda, and pyrite, the mercury being almost completely insulated by the chloroform. This cell, on closing, gave 1.15 volts and 0.3 ampere, with no diminution of current until the ferric hydrate resulting from the action was sufficient to cause an increase in resistance, when, of course, a diminution was noted. The ability of pyrite to depolarize or oxidize in an alkaline solution was shown by an experiment in which a current of two amperes was sent through such a system with a pyrite anode surface of about two square inches, with little or no evolution of oxygen at its surface.

The current that can be taken from such a cell depends on the internal resistance, which is principally due to the asbestos-wick diaphragm and the electrode coating. The solubility of ferric hydrate in sodium-potassium tartrate and other organic substances is well known; if added to the anode solution it keeps the ferric hydrate in solution and thus gives a means of eliminating this resistance due to coating. The deposit, when it becomes sufficient to interfere with cell action, is loosely attached and consequently is easily dislodged by the slightest washing motion. The cell in principle is not new, being merely an adaptation of a well-known form of cell of the Bunsen type, but the use of a mineral sulphide as an oxidizing electrode in such a combination, so far as I know, is new.

The reaction at the cathode in the nitric-acid compartment is fairly well established, the product of reduction being principally nitrogen dioxide (NO_2), which may be converted by air and moisture back to the original nitric acid. At the anode, however, two reactions occur; first, the oxidation of the sulphide to sulphate, then the reaction between the sulphate and the alkali, with the formation of ferric hydrate. Consequently, at the anode, alkali as well as sulphide is consumed. To replace such an alkali as caustic soda would be economically impossible, but fortunately a cheap and abundant source of alkali is available in the form of calcium hydrate. This may be used directly in the cell, which might involve the formation of calcium-sulphate incrustations, which would produce insulation. In that event an indirect method probably could be developed.

Possibilities of Pyrite as a Generator of Electricity

The design of the laboratory cell described cannot, of course, be adopted on a large scale, but it serves to demonstrate the fact that certain mineral sulphides can be oxidized, giving up their oxidizing energy in the form of electricity. It is interesting to note that as a source of electricity, pyrite has about twice the value of zinc, weight for weight; that the quantity of electricity generated by the oxidation of the sulphur of the sulphide is much more than enough to precipitate its metal from the sulphate formed. It may be possible to oxidize the sulphide in one cell (right figure in sketch), generating electricity; and in another cell (left figure in sketch) to use this energy to electroplate the metal from the solution that resulted from the action in the first cell. The reason for this excess energy of oxidation over that needed for metal deposition is evident when it is realized that when oxidizing pyrite (FeS_2) seven atoms of oxygen are required, whereas when reducing FeO to Fe only one atom of oxygen is taken away.

In this paper it has been pointed out that certain mineral sulphides are a possible source of electrical energy. Pyrite seems to be particularly promising for the purpose, especially in view of the fact that it is now oxidized metallurgically in enormous quantities, the result of which is often wasted. A simple laboratory cell has been described which demonstrates the possibility of oxidizing mineral sulphides, with the production of electrical energy. Perhaps the only new matter herein developed is the fact that mineral sulphides such as pyrite oxidize readily as an anode in an alkaline solution.

Tasmanian Mineral Production

The following table, compiled by the Acting Secretary for Mines, shows the quantity and value of mineral products for the State of Tasmania during the year 1921:

Mineral	Quantity	Value £
Gold, oz.	5,340.094	28,395
Silver, oz.	348,658	57,576
Lead, tons	1,434.794	32,241
Copper, tons	6,180.843	463,163
Tin, tons	790.395	130,257
Coal, tons	66,476	63,446
Wolfram, tons	10.34	676
Bismuth, tons	.05	21
Shale, tons	868	1,506
Iron pyrites, tons	606.5	2,579
Scheelite, tons	.....	.....
Osmiridium, oz.	1,750.655	42,935
Asbestos, tons	.....	.....
Zinc, tons	.....	.....
Barytes, tons	.....	.....
Ocher, tons	15	56
Total	.....	£822,851

Copper Smelting by Central African Natives

By Sydney H. Ball

IRON ORE is common in Central Africa, and in consequence the smelter of iron ore and the smith is an important individual in many Bantu villages. But copper is more prized than iron among the natives, and copper smelting has been carried on for centuries, not only in the Katanga, Southeastern Belgian Congo, but also at Bembe, Portuguese West Africa, and at M'Boko, Songo, and Mindouli, French Congo. At these latter two points lead was also smelted.

Although the Union Minière du Haut Katange is now one of the world's largest copper producers, its total production to date only recently surpassed that laboriously produced by the natives. T. W. T. Atherton estimated that the natives smelted at least 100,000 tons of copper, requiring the mining of over 1,000,000 tons of ore and waste. The natives sunk numerous pits and excavated open cuts in their search for copper, and these antiguas in part explain the rapidity with which the copper belt was delimited by the early white prospectors. One of these native open cuts is 720 ft. long, 30 ft. deep and 480 ft. wide at one end, tapering to a point at the other.

The earliest reference to the copper mines was by the Portuguese half-caste traders, P. J. Baptista and Amaro José, who crossed Africa from Loando to Tete in 1802. At Chamuginga Mussenda, a village in the copper belt, they state that the natives "dig the copper; in the midst of this country is where they make the bars." The ore smelted was undoubtedly high-grade malachite and other oxidized ores.

In the December issue of *Congo*, a Belgian review devoted to Colonial affairs, a high government official, F. Ladame, publishes the results of his researches into native mining and smelting methods (pp. 685 to 691). The following résumé of the article may add to the knowledge of primitive mining processes:

The natives no longer exploit the mines, and M. Ladame believes that in the main part of the copper belt no work has been carried on by the natives since the white man knew the Katanga, as is evidenced by trees growing in the pits. In the vicinity of Elisabethville, the last generation of miners has passed away, and the oldest blacks say the secret of smelting has been lost. M. Ladame suggests that the loss of the art was due to internecine wars early in the nineteenth century. In the southern part of the Katanga, however, smelting was carried on in Commandant Lemaire's time, about thirty years ago. The furnace used is shown in the figure, which is sketched from a photograph taken by Lemaire in 1898.

The natives worked not one mine but many mines. In contradistinction to the jealously guarded ownership of hunting preserves and fishing grounds, the copper mines do not appear to have been the exclusive property of any tribe.

The tribal copper metallurgist, like the smith of today, was a man of importance in the community. Each tribe appears to have had a hereditary caste of copper smelters. Their names still linger in the tribal legends, and several of the copper mines still bear the name of the copper metallurgist who smelted its ores (for example, Kipoie, near Sofumango).

The metallurgist alone had the "secret" or the "medicine" necessary to render the ore amenable to treatment. Not only was superstition attached to the art of copper smelting, but the hills from which the ore was obtained were held in awe. No women were permitted at the mines, nor was association of the sexes allowed during the mining season.

The crews of miners from each tribe, under orders of the tribal smelter, reached the mines in April or May, at the beginning of the dry season, during which period alone mining was carried on. The ore was dug out with hoes and hatchets and then carried to the copper smelter and his assistants. The latter, using his valuable "medicine," spread on the ground first a circular

Copper-smelting furnace constructed by natives. Height approximately 10 ft.

layer of charcoal about 1½ ft. in diameter; on this were placed successive layers of ore and charcoal, each bed decreasing slightly in diameter. As the pile rose, it was enwalled with clay 1 to 1½ in. thick. When the pile had become almost 3 ft. high, the top was also sealed with clay and the sugar-loaf-shaped mass was then pierced at the base. Into the holes the nozzles of bellows were placed, these bellows being worked up and down by thin wooden wands. In three or four hours, copper began to trickle through the holes and after the copper buttons had cooled, they were cleaned of slag.

These copper slugs were then collected, resmelted, and cast either into disks, rectangular sheets, or St. Andrew's crosses. Twenty per cent of the product belonged to the copper metallurgist, 40 per cent to the village chief of the miners, 20 per cent to the miners and 20 per cent to the tribal chief.

The village coppersmiths fabricated the metal into thin wrist rings, pins, lance points, hatchets, rifle balls, and bells. Legend states that thin wire twisted into bracelets or anklets were first made by the Bayeke workmen who arrived in the Katanga region early in the nineteenth century. In much of Central Africa copper was one of the most important forms of exchange and was particularly valued by tribes residing at a distance from the mines.

USEFUL OPERATING IDEAS

Coreing Devices for Rotary Drilling In Oil Fields

Various Types of Barrel Designed That Make It Possible To Take a Core of Sand Readily

VARIOUS coreing devices used in rotary drilling are described by R. E. Collom in Bulletin 201 of the U. S. Bureau of Mines. A common objection to most forms of rotary core barrels used is that the hole must be underreamed after drilling a core, with the exception of the attachment with the fishtail bit mentioned below. With most core barrels it is difficult to take a core of sand.

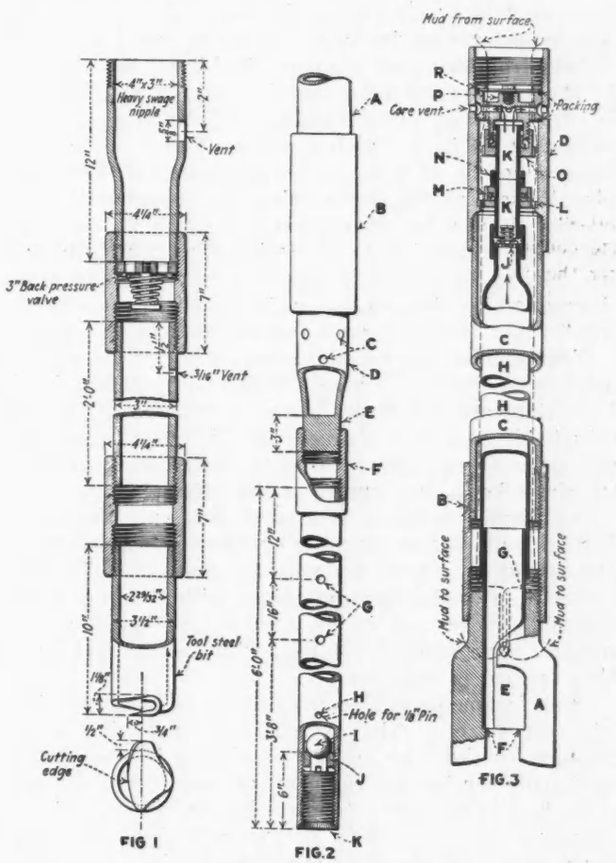
One coreing device used in soft formations has the core barrel in the center of a fishtail bit, this being made so as to have a 1½-in. hollow tube, or the barrel, running up the center. The 1½-in. opening in the shank of the bit is threaded, and pipe is screwed into it of sufficient length to take the amount of core desired. The opening is slightly larger at the top than at the bottom, being thus tapered to catch and hold the core when the drill pipe is pulled out. The hole is held to standard gage when this device is used, and the drilling is done as with the ordinary fishtail bit. The sample, however, is not kept in its original state, and the length of sample does not give the thickness of the formation drilled.

The core barrel shown in Fig. 1, which is extensively used, is made by cutting a lip and bending and blacksmithing it over the bottom of a piece of pipe. It cuts like an ordinary post-hole auger. In pulling out, the lip holds the sample in the barrel, the sample coming out as cuttings. This device is said to be preferred by the Gulf Production Co.

A coreing device used in Holland by the Roxana Petroleum Co. has a shoe, of complicated design, which is screwed on the 6-in. drill stem. The core barrel can be of 4-in. pipe and long enough to take the amount of core desired. The barrel is made up of 1-ft. lengths of flush-joint pipe, the bottom length being screwed into a steel shoe through which watercourses run. Cast steel cutting teeth fit into slots in the bottom of the shoe and can be replaced when worn out, thus avoiding the necessity of blacksmithing. Small springs on the inside of the shoe keep the core from falling out when it is taken. An ordinary back-pressure valve on top of the core barrel allows the mud and water in the barrel to be forced out as the core moves up the barrel, and prevents the drill mud from entering the top of the core barrel. A drawback to this core barrel is that different numbers of teeth must be used for drilling different materials. In using 1-ft. lengths of flush-joint pipe these can be unscrewed and the core pushed out.

In Fig. 2 a coreing device used by the Rio Bravo Oil Co., of Texas, for coreing in soft formations is shown. The hole has to be reamed to size after its use. *A* is the drill stem; *B*, a 4 x 14-in. drill collar; *C*, half-inch holes for mud circulation; *D*, a 2½ x 4 x 17-in. swaged nipple; *E*, a 3-in. solid end; *F*, a 2½ x 6½-in. heavy collar; *G*, ½-in. holes for escape of air; *H*, ⅛-in. round-iron pin to prevent ball going up ahead of sample; *I*, 2-in. steel ball; *J*, removable seat valve for emptying sample; and *K*, cutting edge.

An ordinary piece of pipe in the bottom of which is



Three devices for taking cores in drilling oil wells

cut a small V-shaped notch is used by A. R. Gamble in the Gulf Coast country. This is lowered into the hole and rotated on bottom. It has been found that this core barrel makes a core just as fast as any other style in use and will work in fairly hard formations. The barrel is rotated until the amount of hole desired has been made (cores from 8 to 10 ft. long are commonly taken). The swivel is then unscrewed on the derrick floor and a double-handful of small pieces of cast iron of about the same size as one's fingernail is dropped into the drill stem. The swivel is then screwed back on and the pump started, and as soon as these pieces of cast iron have reached bottom the drill stem is raised a few inches and lowered slowly. After this operation is repeated a few times the tools are pulled out. The pieces of cast iron become lodged between the barrel and the

core and hold the core in the barrel. In using this type of core barrel, it is necessary to ream the hole before drilling ahead. The time required to remove and unscrew drill pipe and set it together again for a fresh run, and the necessity of underreaming, are the principal objections to the use of the core barrel.

A tool combining a vented core barrel, for relief of pressure, with a fishtail bit, is shown in Fig. 3. It has been operated successfully, taking cores of both soft and hard formations. As much as 16 to 18 ft. of hole has been made on one run, given 12 to 14 ft. of core, in pieces, with a maximum length of 18 in. *A* is an ordinary 11-in. fishtail bit with 6-in. shank bored out to 4-in. pipe; *B* is a 6-in. drill coupling; *C* a 6-in. drill pipe. *D* is a special drill coupling that supports and swivels the core barrel and is provided with vent holes to equalize the pressure on the core. *E* is a piece of 4-in. pipe forming the lower end of the core barrel. It is held from dropping through the bit by the offset *F* in the bit *A;* and from pushing up, by the ring *G*. *H* is the main core barrel made of a joint of 4½-in. pipe, swaged to 2½ in. at the top, and on this is attached a 2½-in. coupling. *J* is a back pressure pipe; *K* the swivel pipe; *L* a perforated annular ring that supports the core barrel. *M* is a ball-bearing supported on *L*, carrying the coupling attached to the swivel pipe, thus supporting the core barrel. *O* is a packing box; *P* is the head through which the core barrel is vented to the ascending fluid; *R* is a perforated follower to hold *P* in place.

Okell drilling equipment follows closely the rotary practice of drilling with a fishtail bit. When hard formations are met a core barrel is substituted for the fishtail bit, and it is claimed that the core barrel not only drills faster than cable tools in similar formation, but also takes a true sample of the rock.

The Okell core barrel is used to drill and take cores from all solid rocks, from the hardest to those that are soft enough to be scratched with any dull tool. The core barrel is a plain piece of pipe, with one or more diagonal grooves cut in the ends of the barrel at an angle of approximately 45 deg. with the vertical axis. This feature is patented.

Small fragments of steel are used as an abrasive with this core barrel. The angular slot—revolving in a direction so that the top end is always in the lead—continually carries the fragments of steel from the sides of the hole to the cutting end of the core barrel. When extracted, the cores show perfect angles of dip, but do not show what the direction of the dip is at the point of taking.

Types of Cages and Skips

The mine cage is a light steel platform attached to a steel frame. Shoes engaging with the guides are attached to the frame and prevent any lateral displacement. From one to four decks or platforms are used on a single cage. Large capacity and deep hoisting require from two to four decks. Each deck is equipped with tracks for the car, car hooks, or a yoke swivel on one side to engage the car and prevent it from being displaced, and overhead bars which serve as handholds or for the lashing of timbers.

Gates are necessary where cages are used for handling men, and these are generally arranged as to be easily removed when the cage is to be used for ore hoisting. Removable decks are a feature of cage construction where long timbers or stulls are used. Conspicuous on most cages in Western mines are safety catches which are designed to prevent the cage from falling in the event of rope failure. These catches are advocated by most mining engineers, although they are conspicuously absent in some important mining districts. At best they can be looked upon only as an auxiliary safeguard. Proper use of ropes and thorough rope inspection are the best protection against accidents, with their attendant expense and delays.

The tilting single-deck cage is used in some collieries. By its use the load of coal is dumped at the landing chute and the cage is returned to the level. It avoids unloading the cars and, where single-deck cages are in use, it effects a decided economy. A special type of end-dumping car is required, and as a rule a larger car, capable of carrying from one to two tons, is necessary. Where smaller cars are required by the mining conditions the tilting-deck cage possesses little practical advantage.

Cages are the most common shaft vehicle employed. In collieries the coal is brought to the surface in cars on cages, but in metal mines, even where skips are employed, the cage is necessary for handling both supplies and men. The cage and skip are sometimes used as a combined vehicle. Under other conditions where skips are used auxiliary cages are employed in separate compartments. The carrying capacity of the cage varies between wide limits and depends primarily upon the dimensions of the shaft compartment and the number of decks to the cage. In Western mines the load is a ¾-ton car to the deck (compartment dimensions usually 4.5 x 5 ft.). In coal mines, where larger shaft compartments are the rule, two cars, each carrying from one-half a ton to two tons, are hoisted on each deck. The size of the mine car determines the deck load. The weight of the cage ranges from 1,200 to 1,500 lb. per deck.

Skips are used in incline and vertical shafts in metal mines. They are only occasionally used in coal mines, on account of the dust and breaking of coal caused by the double handling. They are loaded from chutes communicating with shaft pockets and are automatically discharged by the wheels striking a curved runway, which tilts the skip over until the angle is sufficient to discharge the contents. They range in capacity from one to eleven tons, three to five tons being commonly used in mines of moderate output. The ratio of the weight of the load and the weight of the skip ranges from 1 to 2.5, an average figure being 1.5.

In incline hoisting, special man cars are generally used in mines employing 100 or more men per shift. These are arranged so that twenty or more men can be handled per trip without crowding or discomfort, as is often the condition at small mines where no special provisions are made. In deep mines served by vertical shafts special man cages are employed. These are substituted for the skips at the beginning of the shift and are removed as soon as the men are down. In mines of small output the cages used for hoisting ore cars also answer for lowering the workers.

Square or round tanks constructed of steel are used in dewatering, either as an auxiliary to the pumps or for main drainage. They are usually arranged to discharge like a skip, and are provided with bottom or side inlet valves which automatically open and close as the skip is lowered into and raised from the water in the sump. Bailing tanks are made with from 500 to 2,000-gal. capacity.

THE PETROLEUM INDUSTRY

Analytical Distillation of Shale Oils*

By Martin J. Gavin

THE oil-shale studies of the Bureau of Mines, conducted in co-operation with the State of Colorado and the University of Utah, have for their primary purpose the determination of retorting and refining conditions most favorable for obtaining the highest yields of most satisfactory products. Typical oil shales are retorted in carefully controlled retorts of different types; the conditions are varied in successive runs. As a rule, it is easy to determine when the highest absolute yield of oil has been obtained from a given shale, but it is an altogether different problem to ascertain the relative qualities of different shale oils.

Analytical Distillation Is Used to Compare Oils

Thus far the Bureau of Mines has found no more satisfactory method for determining the relative qualities of different shale oils than the analytical distillation method, developed by the Bureau, for petroleum. Certain minor modifications of this method have been found necessary, owing to the peculiar nature of shale oil.

The method used by the Bureau of Mines for examining petroleum and the interpretation of data obtained with it are briefly described below,[1] followed by remarks that indicate the manner in which the method of examining shale oils differs from that used for petroleum.

Each sample was subjected to laboratory tests that yielded the following information:

1. The specific gravity at 60 deg. F. and the corresponding Baumé gravity (based on the modulus 140).
2. The percentage of sulphur. This was determined by burning a weighed quantity of oil in a calorimeter bomb, precipitating the sulphate formed as barium sulphate, filtering, igniting, and weighing.
3. The percentage of water.
4. Distillation at atmospheric pressure with data for the percentages distilling within 25 deg. C. limits up to 275 deg. C. and the specific and Baumé gravities of the fractions.
5. Vacuum distillation at a reduced pressure of 40 mm. "absolute," of the residuum from the "air distillation," with data for the percentages distilling between 25 deg. C. limits up to 300 deg. C. and for the specific and Baumé gravities, Saybolt Universal viscosities (at 100 deg. F.) and Fahrenheit cloud tests of the distillation fractions.
6. Conradson carbon residue percentages of the residuums from the combined "air" and "vacuum" distillations.

The methods employed by the Bureau of Mines for the distillation analysis of crude petroleum have not been developed with the idea of obtaining figures that parallel the results of actual refinery practice. It is believed that, although the most satisfactory use of the figures involves a comparison, there is also a need for some method of "rough-and-ready" interpretation in terms of commercial products. The authors have, therefore, offered the following classification, which, even if it has no other justification, is convenient because it permits discussion in terms of "given names" rather than the determining physical or chemical properties of distillation fractions:

1. The sum of all fractions distilling at atmospheric pressure below 200 deg. C. is reported as gasoline and naphtha.
2. The sum of all fractions distilling at atmospheric pressure between 200 deg. C. and 275 deg. C. is reported as kerosene.
3. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. of less than 50 sec. is reported as gas oil.
4. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. between the inclusive limits of 50 and 99 sec. is reported as light lubricating distillate.
5. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. between 100 and 99 sec. inclusive is reported as medium lubricating distillate.
6. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. of 200 sec. or more is reported as viscous lubricating distillate.
7. Conradson carbon residue tests were made on residuums from the "air" and "vacuum" distillation and the resulting percentages, termed "carbon residue of residuum," are regarded as an index of the asphalt content of the crudes and their suitability for yielding steam cylinder stock when refined.

Analytical Data More Complete

Until recently, the Bureau of Mines has not, except in rare instances, determined sulphur content. However, all crude shale oils now being examined are analyzed for sulphur. It has been found that nearly all shale oils contain rather large percentages of sulphur, the average of those thus far examined being about 0.60 per cent. Also, until recently, Conradson carbon residue tests have not been made on shale-oil residuums. Recent work indicates that the carbon residues of nearly all shale-oil residuums are relatively high, some being over 18 per cent, indicating, as is to be expected, that shale oils usually are not suitable for yielding steam-cylinder stocks.

On account of the high content of solid paraffin wax in many crude shale oils, and shale-oil fractions, it has been found somewhat inconvenient to determine viscosities at 100 deg. F. or 130 deg. F.

Taking Cloud Point Impracticable

The dark color of many of the vacuum fractions and of the crude oils themselves makes the taking of the cloud point impossible. Consequently, on these fractions and on the crude a "setting point" test is made. This method also is of value in that it follows the method used by Scotch shale operators and by them is used as an index of the amount of solid paraffin wax recoverable from the oil. The procedure is to freeze a drop of the oil on the tip of the cooled bulb of a thermometer, then to invert the thermometer, and while rotating it about

*Abstracted from *Reports of Investigations*, U. S. Bureau of Mines.

[1]Dean, E. W., *Reports of Investigations*, Serial No. 2,202. Bureau of Mines.

a vertical axis to permit the temperature to rise at a definite rate, until the drop melts and flows down the bulb. Unless the oil is of an exceedingly tarry or asphaltic nature, the settling point can be sharply and accurately determined. In addition to the tests described above, shale-oil fractions resulting from the distillation at atmospheric pressure are combined, and an unsaturation test is made on the combined fraction.

A word of caution should be spoken regarding the interpretation of vacuum fractions resulting from analytical distillations of shale oils. It will be noted that many of the oils yield vacuum fractions that appear to have properties satisfactory for the production of lubricating oils. However, little is known as to how these fractions would stand refining, or how satisfactory for commercial use the refined lubricating oils would be. The high-carbon residues of the shale oils examined in more recent work of the Bureau would strongly indicate that the production of satisfactory lubricants from many shale oils would present a most difficult problem.

The Evaluation of Shale Oils

Attempts to evaluate shale oils, even for comparative purposes in the laboratory, involve both technical and economic considerations. From a technical standpoint one must consider and determine what possible products can be reasonably expected from shale oils. From the economic side there must be considered which of these possible products will be in greatest demand, and how cheaply they can be placed on the market. During the last several years the petroleum products in greatest demand have been motor fuels, illuminating oils, lubricants, and fuel oils. It seems likely that, first of all, shale oil will be used as a source of motor fuel, and secondly, possibly as a source of fuel oil. Other products will probably be of secondary importance, and it has been finally decided that shale oils may reasonably be evaluated on the basis of the amount and quality of motor fuel they will produce.

An analytical distillation can indicate the relative amount of motor fuel of a given volatility to be obtained from different oils, but it is necessary to be somewhat arbitrary in selecting the range of volatility of the motor fuel, or, in other words, its "end point." In making analytical distillations of petroleum and shale oil, it is the practice of the Bureau of Mines to stop the atmospheric pressure distillation when the vapor temperature in the neck of the fractionating column reaches 275 deg. C. The combined fractions distilling up to this temperature are considered, for purposes of comparison, as representing all the gasoline, crude naphtha, and crude kerosene.

No definite prediction can be made as to the future end point for motor fuel, and accordingly it has been found most satisfactory for purpose of comparison to classify shale oils on the basis of relative percentages distilling up to 275 deg. C. vapor temperature. This distillate is generally spoken of as "tops."

Another point to which attention must be directed is the suitability for refining of this crude motor fuel fraction. Probably this can most conveniently be studied by determining the percentage of "unsaturation" of this fraction.

Definition of "Unsaturates"

For the purpose of this discussion the term "unsaturates" or "unsaturated hydrocarbons" is taken to mean that part of the oil soluble in concentrated sulphuric acid under the conditions of the test above noted. If used with this understanding, unsaturates probably includes the diolefins and part, but by no means all, of the olefins. Just what part percentage of unsaturation will play in the refining of shale oil is not well known at present. Certainly, under commercial practice the refining loss of any distillate will be much less than the absolute unsaturation percentage. However, it is likely that the relative refining losses will be approximately proportional to the respective percentages of unsaturated hydrocarbons in the oils under consideration.

It is difficult to determine accurately by the usual test with sulphuric acid the percentage of unsaturated hydrocarbons in a crude shale oil. The acid tars produced under this treatment are usually markedly viscous and difficult to separate from the oil. On the other hand, it is relatively simple to determine this unsaturation percentage in the tops and to secure on this product closely agreeing results on successive unsaturation tests. Therefore, and again tentatively, the Bureau of Mines compares the qualities of shale oils on the basis of relative percentages of unsaturates in the tops from the oils.

Knowing the amount of tops yielded by the crude oil and the quantity of the tops as indicated by its percentage of unsaturates (also, its percentage of saturated hydrocarbons, as this is obtained by subtracting percentages of unsaturates from 100), an index number tentatively evaluating the shale oil may be calculated. If percentage of tops from a shale oil be multiplied by the percentage of saturated hydrocarbons in the tops, the product is a good numerical index of the value of the oil. If the possible oil yield of the shale has been determined by a standard method, the crude oil yield of the shale, calculated to gallons per ton, multiplied by this index number, gives another number which can be used as an index of the value of the shale, disregarding, of course, certain economic considerations.

The Method Is Necessarily Arbitrary

It should be repeated that this system of classification does not take into consideration the value of the oil other than as a producer of motor fuel, although, as noted, a high yield of motor fuel fraction coupled with low percentage of unsaturates in this fraction is reflected in the quality of the other fractions from the oil. Likewise, it does not take into consideration the absolute volatility range of the motor-fuel fraction, or the percentage of sulphur in the oil. These matters require further study, and perhaps the method will require revision when these factors are properly taken into account.

An application of the method described above may be given. Consider two shales, one yielding fifty and the other thirty-five gallons of crude oil to the ton. The oil from the first yields 38 per cent of tops containing 55 per cent of unsaturates (45 per cent saturated), and the other 35 per cent of tops contain 40 per cent of unsaturates (60 per cent saturated). First evaluating the oils:

Relative value of oil from shale No. 1 = $38 \times 45 = 17.10$
Relative value of oil from shale No. 2 = $35 \times 60 = 21.00$

If the shales themselves are to be evaluated, the numbers obtained as above are multiplied by the respective crude-oil yields of the two shales:

Relative value of shale No. 1 = $17.10 \times 50 = 855$
Relative value of shale No. 2 = $21.00 \times 35 = 735$

By the Way

Whence Came It?

"Are we ready for the shale-oil industry?" asks J. B. Jenson in the *Salt Lake Mining Review*. We are —let her come. But we confess to being a trifle startled by the title of "shaloilogist" which our contemporary in all seriousness bestows on Mr. Jenson. This caught us entirely unprepared. Who fathered this etymological freak and who gave it birth?

The Law's Delay

Butte & Superior's accounting hearing, recently set for April 11 but again deferred, has been so often postponed that it seems to have somewhat the nature of a movable event, like Easter, and one has difficulty in keeping track of it. Repeated postponement and delay are characteristics of legal actions. In the meantime, John Ballot, president of the plaintiff company, dies. Who dares say who of those now active on either side of this famous suit will be alive when the lawyers are finally done with their maneuvering? There is some talk of the case being settled by compromise. We hope so. Dickens wrote a volume on Jarndyce and Jarndyce, a typical chancery case, stretched over generations, and which brought nothing but evil and despair to any of the litigants. Finally the trial came to a sudden halt because the estate, originally large, had been entirely absorbed in costs and fees and there were no more bones for the lawyers to pick.

Better Work Possible

We advise a course in advertising, or something of the kind, for those who prepare the literature used in fake promotions. Some of this is "smooth" and so cleverly written as to deceive even the intelligent, if they be unwary. But by far the most is crude, the work of tyros, and violates all the principles of good advertising. Much of it is difficult to read. A prospectus at hand sprawls over four foolscap pages printed mainly in caps, hard for the eye to grasp and making use of black-face type where emphasis is sought. It violates all our ideas of what's what in promotion literature. It must drive easy money away. We know we could do it much better, if we tried. But we shall not try. We are too busy nowadays.

An Amateur Promotion

A striking bit of stupidity is to be found in the "preliminary prospectus" of the Two-in-One Gold Mines, Ltd., which owns property in the Porcupine district, Ontario. Its authorized capital is $5,000,000 in 5,000,000 shares of $1 par value, for which it is seeking purchasers at 50c. per share. The property consists of eight claims which are on the "same latitudinal line as the great Dome and Hollinger" for which reason, it is said, "they should embrace the same dikes and ledges," since they are only a mile or so away. Much is said of "ore measures" and of the great variety of gold-bearing veins found on the claims and elsewhere in the district, but nothing at all of the value of the ore already found. The salesman who left the prospectus with us said that there was considerable $2 ore on the surface, and he was optimistic that values would improve with depth.

Apparently no development work has been done, for none is mentioned. Instead, the prospectus says, "the results of development are indicated by the official reports of the other mines in the Porcupine area. . . . The environment of these (Two-in-One) properties indicates that they will soon be one of the largest gold producers. . . . The locations of the properties and the success of the mines in the same area furnish *proofs* of rapid and continuous production at a minimum of cost and with every prospect of large profits to the stockholders. This should appeal strongly to the conservative investor."

Selling stock in a company on the strength of the proximity of its holdings to those of known producers is nothing new, but usually the promoter talks convincingly, oftentimes inventing his facts as needs be, as he goes along, especially if the properties are a mile or more apart. The writer of this prospectus invents nothing, but has a facility of jumping to conclusions and making asinine deductions, which we suspect he believes himself. Apparently he can visualize the future as readily as Conan Doyle can the hereafter, even to the extent of creating imaginary reserves in stopes in ground as yet undrilled.

West and East

A friend recently remarked, apropos of the *Journal-Press* merger, that he never expected such a consolidation, for, as Kipling said,

"East is East and West is West, and never the twain shall meet."

He was reminded, however, that the complete verse runs as follows:

"Oh, East is East and West is West, and never the twain shall meet,
Till Earth and Sky stand presently at God's great Judgment Seat;
But there is neither East nor West, Border nor Breed nor Birth
When two strong men stand face to face, though they come from the ends of the earth."

The Elimination of Waste

"I see w'ere they 'ave been makin' a gert fuss baout this 'ere waste in h'industry; savin' 'ere, stoppin' there, an' tryin' to 'old daown tha cost o' h'everything an' speed tha h'output," said Cap'n Dick. "If they don't 'arp too much h'on one thing, or some things—savin' h'at tha spigot an' wastin' h'at tha bung'ole, so to speak —h'ought to do a 'eap o' good, seems to me. Never will do, any'ow, to work h'out like Jan Tregillis' trainin'. Jan started h'in, w'en 'ee firs' come h'over 'ere, workin' at one o' there 'ere h'open pits. 'Ad no h'other work to put 'im to, so super gives 'im a job workin' in tha shop, h'oilin' h'engines. Tha foreman wuz a savin' chap, an' wuz mighty set h'on tha Safety First h'idea too. So h'each day 'ee'd tell h'all tha men to take good care o' theyselves, an' h'in particular 'ee'd tell Jan to make no squandering o' tha h'oil an' waste. Persistent beggar, 'ee wuz, an' Jan wuz a good listener. Come one day w'en they needed a fireman h'on one o' tha h'engines h'in tha pit, an' Jan wuz given tha job. So tha pit boss sez to 'ee, by way o' tryin' 'im h'out, ' 'Ere, you, supposin' naow you're h'in tha h'engine, runnin' roun' a curve, an' thee sees one o' tha h'other h'engines commin' full speed towards thee. W'ot's thee goin' to do?' 'Dam-me,' sez Jan, 'Simple nuff. I'll grab tha h'oil can an' tha bloody waste, an' jump.' "

SOCIETIES, ADDRESSES, AND REPORTS

Northwest Mining Association Urges Unity in Blue-Sky Laws

The Northwest Mining Association has officially endorsed a suggestion made by J. F. Callbreath, secretary of the American Mining Congress, which is to the effect that a meeting of Western mining interests be held at Salt Lake City or some other central Western point, with the object of arriving at a concerted basis of action looking to the simplification and unification of state legislation with regard to "blue-sky" laws. The association has also passed the following resolution, copies of which have been forwarded to all Washington, Idaho and Oregon Senators:

"Whereas, The Senate Finance Committee is reported to have removed cyanide from the free list, with the recommendation that it be subject to an import tariff of 10 per cent ad valorem; now, therefore, be it,

"Resolved, by the Northwest Mining Association, of Spokane, Wash.. this the sixth of April, 1922, that in its opinion the proposed import tax would act as a serious handicap to the precious metal mining industry of the West, already suffering from excessive costs in every direction. And be it further,

"Resolved, that copies of this resolution be forwarded to members of the Senate Finance Committee and to Senators Jones and Poindexter, with the urgent request that they use their influence toward retention of this essential compound upon the free list."

F. A. E. S. to Make Survey of Industry

A survey of American industry to ascertain "what steps have been taken to smooth out the business cycle" has been started by the American Engineering Council of the Federated American Engineering Societies. Each of the thirty member societies of the federation will participate in the survey, which is undertaken at the request of Secretary of Commerce Hoover.

Each member organization, headed by Dean Mortimer E. Cooley, will be enlisted in the task of covering the industries in its locality.

Secretary Hoover had previously presented to the executive board of the American Engineering Council, through the executive secretary, L. W. Wallace, the question of a proposed investigation of intermittent unemployment and cyclical depressions as an outcome of the work of President Harding's conference on unemployment.

"The largest area of waste lies in the periods of slack production and unemployment due to the ebb and flow of economic tides between booms and slumps," said Mr. Hoover. It was Mr. Hoover's plan that parts of the investigation which he suggested fall in the same general field as that explored by the Waste Committee, especially those of the long-range plan of the construction and maintenance work of the industries.

The survey of industry which has just been started will come up for discussion at the next meeting of the council's executive board in Pittsburgh early in May. It represents an extension of the program of public service initiated by the engineers of the nation while Mr. Hoover was president of the federation and which is being carried on under the direction of his successor, Dean Cooley, aided by a group of prominent engineers, educators, and economists representing practically every industrial centre.

Sulphuric Acid Plant at Anaconda

The Montana Society of Engineers met in Helena on April 6, 7 and 8. A paper, "The New Sulphuric-Acid Plant at Anaconda," was presented by E. S. Larison, and detailed the progress made by the Anaconda in its series of experiments to lessen the cost of the manufacture of sulphuric acid and reducing the factory area required for its production. The Anaconda's engineering department has conducted successful research in this direction, the objective of which is the use of sulphuric acid in connection with the manufacture of fertilizer or phosphate rock, two tons of acid being required in the treatment of one ton of phosphate rock, and with the accomplishment of the object assured the Anaconda has gone forward with its fertilizer development plans on a broad scale, particularly in the development of its phosphate deposits near Soda Springs, Idaho.

Utah Oil Possibilities Discussed

The bi-monthly meeting of the Rocky Mountain Association of Petroleum Geologists was held at the Albany Hotel, Denver, Col., on April 13. The feature of the meeting was a paper by Max Ball on the petroleum possibilities of the Tertiary of the Uinta Basin, Utah.

San Francisco Section, A. I. M. E

The San Francisco Section of the A. I. M. E. held its regular monthly meeting on April 11. Newton Cleveland presented a paper on "Gold Dredging in California."

Utah University Offers Research Fellowships

Announcement of fellowships in mining and metallurgical research offered by the University of Utah for the year 1922-1923 has been made by Dr. Joseph F. Merrill, director of the School of Mines and Engineering. Invitation for application for the fellowships is extended to qualified men, college graduates who have had a good training in chemistry and metallurgy. The applications will be received up to May 15, 1922, addressed to Professor Merrill at the University.

The fellowships have an annual value of $720, and as the Department of Mining and Metallurgy is maintained in connection with the Utah Station of the Bureau of Mines and is a department of co-operative research, the holders of the fellowships will be subject to the rules governing employees of the Bureau of Mines, and will report for duty about July 1, 1922. They must also register as students of the University of Utah and become candidates for the degree of Master of Science, unless this or an equivalent degree has been previously earned. The fellows are appointed for one year, but the appointments may be renewed, and they pay no laboratory fees.

California Dredge Operators Meet

The California Dredge Operators held their monthly meeting in San Francisco on April 7. More than forty dredge superintendents and others were present. Charles M. Romanowitz, presented a paper an the design of gold dredge buckets, which reviewed the history of the subject in an interesting manner. D. H. Young, of the American Manganese Steel Co., discussed the practical difficulties involved in the foundry work upon manganese steel buckets. He pointed out the mechanical troubles and explained the manner in which they are being eliminated. E. C. Parker, who recently returned from Siberia, informally discussed placer mining districts upon the Amur River, in the Far-Eastern republic.

Joint Meeting Denver Sections A. I. M. E. and A. I. E. E.

Dean Fulton of the Missouri School of Mines addressed a joint meeting of the Denver Section of the American Institute of Electrical Engineers and the Colorado Section of the American Institute of Mining and Metallurgical Engineers on April 14, on the subject of the "Electro-Thermic Process of Dry Distillation of Zinc from Complex Ores."

MEN YOU SHOULD KNOW ABOUT

James P. Porteus has gone to Lawrence, Kan.

G. C. Bateman, of the La Rose mine, at Cobalt, has left on a trip to Los Angeles.

C. N. Miller, of San Francisco, has been inspecting properties in the Lordsburg, N. M., district.

L. M. Kniffin has returned to Fierro, N. M., as manager of the Hanover Bessemer Iron & Copper Co.

R. L. Lloyd, of the Dwight & Lloyd Sintering Co., New York, sailed on April 15 for a three months' trip to Europe.

H. G. Young, of Montreal, has completed an examination of Ontario Kirkland mines for Montreal Kirkland interests.

A. Burt, manager of the Kirkland Lake Proprietary, has arrived from London to inspect the company's property.

John W. Prout, manager of the Central Copper Co., of Dos Cabezas, Ariz., is making a trip to New York and Danville, Pa.

H. T. Reifel, former superintendent of the La Rue mine, Nashwauk, Minn., has accepted a position with the United States Railroad Administration.

Horace Pomeroy is now manager of construction of the hydro-electric dam for the Georgia Railway & Power Co. on the Tugalo River, Georgia.

A. W. Newberry left New York on April 17 for a four months' stay in Nevada, where he will be occupied in reopening a silver mining property.

Walter G. Perkins and **Preston K. Horner** have established their office as consulting mining and metallurgical engineers at 62 London Wall, London, E. C. 2.

Charles L. Harrington has purchased the engineering office of **W. A. Funk** in Idaho Springs, Col., and will conduct a general engineering business as related to mining.

Kuno Dorr, general manager of the American Smelting & Refining Co.'s plants in Colorado, returned to Denver on April 10, from a visit to the New York offices.

F. C. Lincoln, of the University of Nevada, at Reno, recently visited San Francisco to confer with the officials of the Berkeley Station of the U. S. Bureau of Mines.

Gordon R. Campbell, president of the Calumet & Arizona Mining Co., is making a tour of inspection of the company's properties at Ajo and Warren, Ariz., and Lordsburg, N. M.

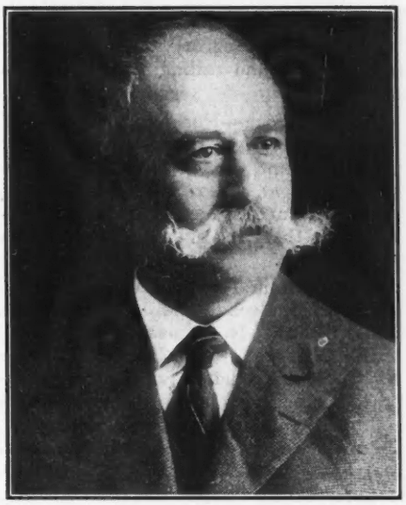
William H. Bard, for the last four years with the engineering staff of the Phelps Dodge Corporation, at Tyrone N. M, is now engineer for the American Smelting & Refining Co. at Santa Barbara, Chihuahua, Mexico.

Bulkeley Wells, president of the Metals Exploration Co. and chairman of the Colorado Metal Mining Board, returned to Denver on April 15, after a six weeks' visit in New York City.

Morris Kullman, of New York, was a recent visitor in Phoenix, Ariz., in connection with the Stargo mine, of Morenci, for which he has furnished funds for the erection of a silver mill.

William Wearne, general superintendent for the Inland Steel Co.'s iron mines, has returned to Duluth, Minn., from California, where he has been on a leave of absence for several months.

General Pedro Nel Ospina, the President-Elect of Colombia, arrived at the United States on April 21 for a visit to this country. Of particular interest is the fact that General Ospina was educated at the University of California, at Berkeley, where he took a course in engineering and metallurgy.



Photograph by Underwood & Underwood

General Pedro Nel Ospina

After a post-graduate course in France, he returned to Colombia, where in partnership with his brothers, he founded the firm of Ospina Hermanos. This firm operated in Medellin a smelter for precious metals. He was also the active head of other enterprises, including cotton and coffee planting, and cattle raising. After a military and political career General Ospina was appointed Minister from Colombia in Washington, and in 1916 was sent as plenipotentiary to Holland and Belgium. General Ospina will enter upon his duties as President of Colombia next August.

Frank H. Sistermans has gone to Mexico on professional business and expects to remain there several months. His address will be in care of Hotel Cosmopolita, Guadalajara, Jalisco, Mexico.

Rudolf Gahl expects to complete his work in connection with the beneficiation of the low-grade silver ores at Cerro de Pasco and intends to return to the United States in a few months' time.

Fayette A. Jones, geologist, of Albuquerque, N. M., and formerly president of the New Mexico State School of Mines, is making a geological survey of the region about seventy-five to eighty miles east of El Paso, Tex., in Hudspeth and southern Otero counties.

J. M. Blayney, of St. Louis, Mo., president, and **W. C. Balm,** of Rosiclare, Ill., superintendent, of the Fairview Fluorspar Co.; **E. P. Hettiger,** of Cincinnati, manager of the Hickman, Williams Co., and **R. B. Ladoo,** of the U. S. Bureau of Mines, who have been inspecting the fluorspar mines of New Mexico, left for Los Angeles on April 9.

D. D. Irwin, formerly in charge of operations of the Moctezuma Copper Co. at Nacozari, and recently appointed general superintendent of the Copper Queen branch of the Phelps Dodge Corporation, has been visiting company properties at Tyrone, N. M., and Clifton-Morenci, Ariz. He will assume his new duties at Bisbee, Ariz., on April 10.

F. W. Bradley gave a luncheon on April 6 at the Pacific Union Club, San Francisco, in honor of **W. R. Ingalls,** who described the present position of the metal markets. Those present were **A. P. Anderson, Eugene Braden, Albert Burch, W. H. Crocker, R. S. Handy, C. T. Hutchinson, E. A. Julian, Jules Labarthe, C. W. Merrill, S. M. Morse, E. H. Nutter,** and **T. A. Rickard.**

Philip Seabury Smith, who recently became associate editor of *Ingenieria Internacional,* was graduated in electrical engineering from Yale University, Sheffield Scientific School, in 1907. From October, 1907, until March, 1916, he was employed by the General Electric Co. in different capacities, and during part of this time was in the foreign department at Schenectady in general supervision of sales. Following this work Mr. Smith became affiliated with the Department of Commerce, where he remained for about six years. During this time he traveled extensively in the West Indies and South America, investigating and reporting on a variety of projects. Mining operations were studied as to methods used and the opportunity for installing American types of apparatus. He was later appointed in charge of the office of Commercial Attaché to the American Embassy in Lima, Peru, and last year was made chief of the Latin American Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C.

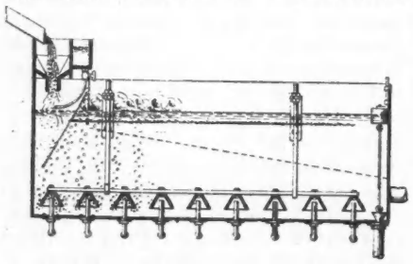
Mining and metallurgical engineers visiting New York City last week included: **N. A. Eilertsen,** of Hancock, Mich.; **W. A. Richards,** of Pottsville, Pa.; **H. A. Wheeler,** of St. Louis, Mo.; **George L. Collord,** of Pittsburgh, Pa.; **Frank L. Nason,** of West Haven, Conn.; **Edward N. Cooper,** of Camp Hill, Pa.; **W. A. Ross,** of Montreal, Quebec; **T. S. Dunn,** of Atlanta, Ga.; and **E. H. Dickenson,** of Philadelphia, Pa.

Recent Patents

Treatment of Oxide Copper Ores—No. 1,407,045. E. B. Thornhill, Hurley, N. M. The oxides are dissolved by sulphuric acid or other suitable agent, and the copper precipitated by sponge iron which has not been further ground after reduction from iron oxide. The copper, in the form of a flocculent precipitate, is recovered by flotation.

Screening Ore—No. 1,407,229. R. V. Smith, Eureka, Utah. A sizing device for ore, consisting of a screen submerged in water, with apparatus for vibrating it, and equipment for removing the products.

Flotation Cell—No. 1,407,258. A. H. Connors, Mullan, Idaho. In this flotation machine the air is introduced



through nozzles over which are a series of inverted V-shaped hoods.

Hydrometallurgy—No. 1,407,324. W. J. Browning, Huelva, Spain. A process for the extraction of metals from solution which consists in passing sulphurous gases containing hydrogen sulphide through the solution to precipitate the metals as sulphides, treating the residual gases to convert at least a part of their sulphur content to hydrogen sulphide, and repassing them through the solution. Patent No. 1,407,323 covers the manufacture of hydrogen sulphide by passing sulphurous gases through an incandescent carbonaceous zone, in the presence of hydrogen.

Reduction of Ore—No. 1,407,372. W. E. F. Bradley, New York. A method of reducing ores which comprises distilling a hydrocarbon gas from coal, utilizing it as a reducing agent for the ore, and utilizing the resulting coke, out of contact with the ore, as a source of heat for maintaining the temperature of the ore during reduction.

Leaching Copper Ore—No. 1,407,420. N. V. Hybinette, Ottawa, Ont., assignor to Kristianssands Nikkelraffineringsverke, Christianssands, S. Norway. Copper sulphide ores are subjected to at least two roasting and leaching operations and the solutions so obtained subjected to electrolysis. Before the second roasting, the ore is treated with a solution of salts, which promotes the subsequent operations. The roasting and leaching are so carried out, and a sufficient excess of the electrolytic solution is separated, to maintain the iron content of the solution low enough to permit electrolysis without diaphragms.

Cyaniding Carbonaceous Ore—Canadian patent No. 217,519. The Merrill Co., San Francisco, assignee of Albert Silver, Tonopah, Nev. The ore, containing carbonaceous matter, is ground in water, mixed with an oleaginous substance, and without separating the carbonaceous matter from the ore, subjected to a cyanide treatment.

Recovery of Thorium—No. 1,407,441. L. W. Ryan, Chicago, assignor to Lindsay Light Co., Chicago. Thorium is separated from an acid solution containing the rare-earth metals and iron, by adding a water-soluble sodium metaphosphate of the character produced by the gentle heating of a phosphate containing sodium and hydrogen, as described.

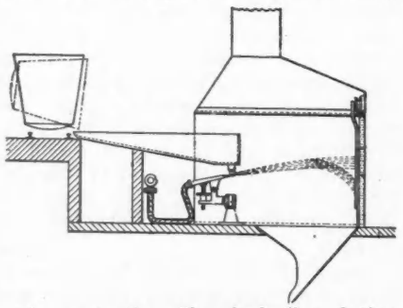
Ore Washer—No. 1,409,385. A. McDougall, Duluth, Minn. An ore washer comprizing two inclined troughs, one above the other. Ore and water, in the upper, discharge through openings in the bottom on to an endless conveyor belt in the lower trough, which discharges dewatered ore at the upper end while water and tailing pass off at the lower end.

Casting Slag—No. 1,402,363. W. T. Hurst, Pittsburgh, Pa., assignor to Slag Rock Machine Co., Pittsburgh. Slag is poured in a water-cooled mold, and when the surface has solidified water is applied, thereby quickly cooling the entire mass.

Molybdenum Extraction—No. 1,403,477. F. M. Becket and J. A. Holladay, Niagara Falls, N. Y., assignors to Electro Metallurgical Co., Niagara Falls, N. Y. The molybdenum ores or concentrates are leached with an alkaline sodium compound of proper strength, the molybdenum precipitated as calcium molybdate, and the precipitate smelted.

Chlorinating Silver—No. 1,403,516. P. R. Middleton, New York, assignor of one-half to J. C. Lalor, New York. A moist charge containing silver ore and a heavy-metal chloride is dried and heated, thereby chlorinating the silver, which is then extracted.

Dry Granulation of Slag—No. 1,404,142. F. Riedel, Duisburg, Germany,



assignor to the Chemical Foundation, Inc., of Delaware. The air or other medium used for granulation is passed through a movable nozzle by means of which the granulated slag may be thrown against any part of a cylindrical cooling wall.

Technical Papers

Engineers' License Laws—Copies of the acts in those states in which all-inclusive license laws for professional engineers have been enacted have been compiled and are published by the American Association of Engineers, 63 East Adams St., Chicago, Ill.; price, 50c. It is stated that this association issued a pamphlet in 1920 containing copies of the engineering license laws in Florida, Iowa, Michigan, New York, and Virginia, and since then local chapters and members have been instrumental in obtaining the enactment of laws in eight additional states.

Soapstone—The U. S. Bureau of Mines, Washington, D. C., has published a four-page mimeographed bulletin on "Soapstone." (Reports of Investigations, No. 2,327, obtainable on request.) The report gives various analyses, and discusses occurrence, production, mining and milling methods, and utilization of the final product.

Candelaria, Nevada—The geology of this old silver camp in western Nevada, which has produced $20,000,000, is discussed in U. S. Geological Survey Bulletin 735-A, twenty-two pages, obtainable on request from the Survey at Washington, D. C. There is some hope now of treating on an economic basis some of the rebellious ore on the upper levels of the old bonanza mines, but "to achieve success in reviving Candelaria will especially require engineering and administrative skill of the first order."

Metallurgy of Tin—An article in the March issue of *The Metal Industry* (99 John St., New York; price 10c.) discusses the essentials of modern methods of smelting and refining tin. The article covers only a little over two pages and is therefore incomplete and sketchy, but details of current practice are kept closely guarded.

Mineral Industries of Washington—The Washington Geological Survey, Olympia, Wash., has issued two bulletins, No. 21, "The Mineral Resources of Washington, With Statistics for 1919," and No. 23, "The Metal Mines of Washington," which describe in detail the various properties in the state, with especial emphasis on geological conditions. Bulletin 21 contains a good map of the state, showing the situation and names of all mines, quarries, and other plants connected with the mineral industries. Copies may be obtained from State Librarian, Olympia, Wash., at 50c. for No. 21, and $1 for No. 23.

Colemanite in Nevada—U. S. Geological Survey Bulletin 735-B (Washington, D. C., seventeen pages, free on request) discusses geological conditions relating to the deposits of colemanite in Clark County, Nev. This mineral is a source of borax.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

MANY tariff amendments have already been introduced, following the reporting of the Senate bill last week. Special exception to certain sections is taken by Senator Oddie, of Nevada, and Senator Nicholson, of Colorado.

Butte & Superior and Minerals Separation may settle their differences by compromise, according to a current rumor.

J. D. Wolf, owner of a flotation patent for which he claims priority, has filed suits against Minerals Separation and forty-four other alleged infringers.

The Lake Superior iron country is showing increased activity, preparations now under way indicating an improvement in the situation soon.

A strike, wage increase and return of the workers followed one another rapidly at the properties of two companies in the Joplin-Miami district last week.

In the Alworth Stephens Co. income tax case, Judge Morris, at Duluth, ruled recently that a lessee was entitled to a deduction for depletion as well as the lessor.

The Hibbing Village removal suit is to go to the U. S. Supreme Court.

A new schedule on zinc ores, of importance to British Columbia operators, has been announced at Trail.

New Zinc Schedule Announced by Trail Smelter

Prompt Settlement Provided For—Expected to Benefit Producers of East and West Kootenays

By Telegraph to "Engineering and Mining Journal-Press"

Spokane, Wash., April 17—Announcement of a new schedule of payment for zinc in ores has been made by the Consolidated Mining & Smelting Co. of Canada, whose smelter is at Trail, B. C. The schedule provides for payment on a sliding scale running from 30 to 50 per cent zinc. Sixty per cent of the zinc in ores containing 30 per cent zinc will be paid for, and 85 per cent of the zinc in 50-per cent ores will likewise be paid for. Intermediate stages are also duly determined. The charge for smelting residues of ores containing 30-per cent zinc will be $8.30 per ton, and $5 per ton for ores containing 50 per cent zinc.

The settlement for zinc will be 3.6c. per lb. off London quotations of the week of arrival. In smelting residues, payment is provided for 80 per cent of the gold, 80 per cent of the silver, and 80 per cent less five units of the lead, wet analysis. The London price for lead and the foreign-price for silver, as given in *Engineering and Mining Journal-Press* quotations for the week, will rule.

Payment is to be made in full soon after sampling. The schedule is effective now on straight zinc ores but not on mixed ores until the custom plant now under construction is completed, which will be about July 1.

The new arrangement is regarded as important to the East and West Kootenay producers, as furnishing a market for a class of ore hitherto hard to dispose of in those districts, especially when low prices prevail.

Old Dominion Starts Furnace

By Telegraph to "Engineering and Mining Journal-Press"

Globe, Ariz., April 17—The Old Dominion company started a blast furnace April 17. A second furnace will be blown in soon. A monthly output of over 2,000,000 lb. of copper is expected. Ore bins are full, and there is plenty of coke on hand. The suspension lasted for a few days over a year.

Gold Output of New South Wales and India

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 13—The output of gold in New South Wales, during January, February, and March totaled 8,740 oz.

The production of gold in India during March amounted to 32,115 oz.

Trona Corporation Resumes

The American Trona Corporation resumed operations on April 10 at Searles Lake. It is said that there are expectations of a record output of potash and borax in the near future. Except for new condensers, there is no change in the plant's equipment and in the process used.

Results of recent research will be applied to the production of several by-products as soon as practicable. The dry concentration plant in Death Valley is in successful operation, treating colemanite. It is said that the company intends moving its Bayonne, N. J., refinery to Los Angeles.

Wolf Sues Minerals Separation and Forty-four Others

Actions for Alleged Infringement Brought Just Before Patent Expires—Priority of Invention Claimed

Jacob D. Wolf, acting through the Wolf Mineral Process Corporation, a proprietary company, has brought suits against the Minerals Separation North American Corporation and forty-four mining companies, all of whom he claims have infringed on his flotation patent No. 787,814, issued April 18, 1905, and which therefore expired soon after the suits were filed. It is set forth in the bills of complaint that the process had been so carried on that the complainant had been unable sooner to ascertain the facts as to infringement, and, also, that the inventor had not been heretofore financially able to bring suit, but that the infringement suits are now being diligently prosecuted.

Among the companies against whom suit has been brought are the following: Federal Mining & Smelting Co.; Belmont Wagner; Calaveras Copper Co.; Consolidated Mines Co.; Federal Smelting & Refining Co. and the Miami Copper Co., Delaware corporations; and Kennecott Copper Co. and the Nevada, Ray and Chino companies, incorporated in Maine; also others of prominence.

Wolf's patent, No. 787,814, April 18, 1905, is prior to Minerals Separation, Sulman, Picard and Ballot patent No. 835,120, Nov. 6, 1906, by a short period. Mr. Wolf had made (following the description and drawings shown in his patent specifications) a model apparatus, from the operation of which, in accordance with the manipulations as

now read from the same patent specifications, it is claimed that air froth flotation was obtained.

As to the quantity of oil employed, Wolf explained, following Judge Bourquin's decision in the Butte and Superior case, that though he used bulk oil proportions, neverthless, the proportion of "frothing oil" in the oil which he used was so small that his process had therefore disclosed the use of less than 1 per cent of oil.

Colorado Legislature Convenes in Special Session

Laws to Make Possible Flood Control and Tunnel Construction Will Be Considered

A special session of the Colorado Legislature was called by Governor Shoup for April 17, to enact laws providing for the organization of conservation districts for flood protection and for the construction of tunnels through mountain ranges in Colorado "for the purpose of aiding transportation and communication and to facilitate commercial intercourse within the state." These measures, which at this time seem certain of enactment, have special application to the creation of a conservation district near Pueblo, to prevent a repetition of last summer's flood, and to authorize and finance the construction of a tunnel near James Peak on the line of the Moffat Road, which would afford improved transportation facilities to a large area in northwest Colorado, rich in agricultural and mineral resources.

Amount Due Smith from Hovland Greatly Reduced

Hoval A. Smith is to get only $145,779.01, in his accounting action against Henry A. Hovland, instead of more than $1,000,000, to which he had been considered entitled by a master in chancery, Edwin F. Jones, who has been taking testimony in the action for a year. Judge Dooling, in the U. S. District Court, confirmed all the findings of the master, but refused concurrence in that section of the report that would have made Hovland responsible for $878,200 accruing through the sale of the Live Oak property at Miami, Ariz., to the Inspiration Consolidated and through the resultant Inspiration dividends.

In the final decree Hovland is declared liable to the extent of 15,700 shares of Inspiration Consolidated, valued at $255,125, and interest on the sum to the amount of $123,840. Hovland was adjudged to have had the right to dispose of 7,850 shares of Live Oak Development Co.'s stock, for the benefit of the partnership between himself and Smith.

Government Calls for Bids for Nitrate

The War Department has called for bids for 40,000 tons of sodium nitrate. Opportunity will be offered for purchases of the material in quantities as small as 100 tons.

Wage Increase Follows Walk-Out in Joplin-Miami District

To Have Been Granted Anyway—Trouble, Now Over, Attributed to Visiting Coal Strikers

BY P. R. COLDREN

Labor trouble visited the Joplin-Miami district for the first time in many months on April 14, when between fifty and one hundred miners at the Chanute Spelter Co.'s Hartley mine, near Baxter Springs, Kans., and the Kanok Metal Co.'s Premier mine, at Picher, Okla., walked out for higher wages. The walk-out, which took place at the Hartley mine on the morning of Friday, April 14, and at the Premier mine in the afternoon of the same day, resulted indirectly from numerous predictions of a wage increase made since the price of zinc and lead ore began advancing. Miners of the companies named evidently concluded to try to hasten the increase, which had virtually been promised by the operators as soon as a $30 price for zinc ore had been reached. Last week the price ranged from $27 to $29.50.

Oddly enough, the walkout came just when a wage increase had been decided upon by virtually all of the larger companies of the field. It is to the amount of 25c. per shift for the machine men and helpers, with a proportionate increase for shovelers and top men. Though wages have not been absolutely uniform at all the mines, in most properties machine men have been getting $3.25 a day and helpers $2.75. The increases granted make these wages $3.50 and $3. Most of the mines in the central part of the district have been paying shovelers from 7 to 9c. per can, but varying conditions and sizes of cans have made impossible an exact schedule for shovelers. An attempt will be made to give them such advances as will make their net increase approximately the same as that for the machine men.

With the establishment of the increased wages, the walkout ended, and it is predicted that no further trouble will develop. Strikes in the Kansas coal fields have resulted in the immigration of some of the coal miners to the zinc and lead fields, and they are sometimes a disturbing element.

Hibbing Removal Suit to Go to Supreme Court

The injunction suit which was started by a group of residents in the older part of Hibbing, Minn., against the Oliver Iron Mining Co. and the Village of Hibbing to prevent the moving of a part of the original townsite, is to go to the United States Supreme Court. Word has been received from Judge Andrew, associate justice, that the petition of the plantiffs asking that a writ of error be granted by the Supreme Court has been granted. This will allow a review of testimony and the U. S. Supreme States Court will pass on the writ of error. The first trial resulted in favor of the defendants, but the case was appealed.

Income Tax Ruling Reversed in Alworth-Stephens Case

Lessee Held Entitled to Deduction for Depletion in Figuring 1917 Tax, As Is Lessor

In awarding the Alworth-Stephens Co., of Duluth, Minn., $17,123.44 in its suit against the Collector of Internal Revenue for Minnesota, Judge Page Morris recently filed a decision in Federal court at Duluth which will be of keen interest to the mining profession generally. The decision holds that the lessee of an iron mine was entitled to figure its income tax for 1917 with a deduction for depletion from its receipts for that year, to the extent of the March 1, 1913, value of his interest in the mine. The decree contradicts all previous rulings of the Internal Revenue Bureau and the Circuit Court of Appeals of Ohio. It is stated that an appeal will be taken to the Eighth Circuit Court of Appeals.

The Alworth-Stephens Co., lessees of certain iron ore properties, had subleased these properties to operators prior to March 1, 1913, and its entire source of income was represented by the difference between the royalties which it received from said operators and those which it paid to its lessors. The award represents the sum of an additional tax demanded by the Internal Revenue Collector which the plaintiffs paid under protest. The Revenue Bureau held that the lessee did not have a property interest in the mines as of March 1, 1913, but that it purchased the amount of ore mined each year and sold it at a profit, all the royalties which it received above those paid the owners being profits of income for the year.

Judge Morris holds that a lessee of a mining property interest is just as much the owner of property in the mine as the fee owner, and is as much entitled to a deduction for depletion to the extent of the March 1, 1913, value of his interest in the mine as is the lessor. It is concluded that both the lessee and the lessor are entitled to depletion in figuring their taxes for 1917, proportionally to the value of their respective interests as they existed March 1, 1913.

Hollinger Conferring to Secure Larger Power Supply

Important conferences have been held recently between the Temiskaming & Northern Ontario Railway Commission, of Ontario, the Abitibi Paper & Pulp Co. and the Hollinger Consolidated Gold Mines, Ltd., of Porcupine, with a view to settling the question of the development of power on the Abitibi River, in Ontario. Some time ago the Hollinger made application for the rights to develop this power, but there were certain interests of the Abitibi company which had to be safeguarded, and to settle the matter the rights were given to the T. & N. O. commission. There is a report that the Hollinger and the Abitibi companies may join in the development.

News from Washington

By PAUL WOOTON
Special Correspondent

Many Amendments to Tariff Bill Introduced

Oddie Wants Cyanide on Free List—Nicholson for Duty on Manganese Ore and Oxide

A flood of amendments is being introduced in the Senate by those who disagree with the tariff conclusions of the Finance Committee. Senator Oddie has introduced an amendment restoring cyanide to the free list. He is outspoken in his criticism of the Finance Committee in amending the bill so as to make all cyanides subject to a duty of 10 per cent ad valorem. He declares it is the duty of Congress to insure free cyanide to the gold producers of this country because of the bearing which the production of new gold has on the whole financial structure. It is his opinion that a duty would be in the interest of a German trust and that it would discriminate in favor of German manufacturers as against American manufacturers who had constructed their plants just across the Canadian frontier, so as to secure the advantages of waterpower. He also told the committee that a duty on cyanide would preclude absolutely the treatment of millions of tons of tailings.

Senator Nicholson, of Colorado, has introduced an amendment providing a duty of 1c. per lb. on amorphous graphite, instead of 10 per cent ad valorem as prescribed by the House bill and the Senate committee. He advocates increasing the rate of 2c. per lb. on crystalline flake graphite, proposed by the Senate committee, to 5c. per lb. At the same time, he strikes out the 20 per cent ad valorem rate proposed by the Senate committee for crystalline lump and suggests a rate of 3c. per lb.

In another amendment, Senator Nicholson proposes to increase the duty on zinc oxide and on lithopone to 2c. per lb.

Senator Nicholson is particularly out of sympathy with the action of the Senate Finance Committee in placing manganese ore and oxide of manganese on the free list. He has introduced an amendment intended to restore the House provision which calls for a rate of 1c. per lb. on the manganese content of ore and concentrates. He also proposes to restore the House rate of 2½c. per lb. on the metallic manganese contained in ferromanganese. The Senate committee amended the bill so as to make the ferromanganese rate $2.50 per ton.

Engineers Confer at Washington on War Minerals

Mining engineers who have specialized in war minerals are to be designated to co-operate with Army officers in the study of the strategic mineral situation in the hope that peace-time activities can be directed so as to contribute most to the national defense in case of an emergency. The entire subject of war minerals was discussed in Washington last week by Pope Yeatman, J. E. Spurr, George Otis Smith, H. Foster Bain, and Colonel Arthur S. Dwight, who are members of the Committee of the American Institute of Mining and Metallurgical Engineers requested to co-operate with the War Department on this matter.

News by Mining Districts

London Letter

Great Boulder Proprietary Ventures Into Argentina—Rio Tinto's Report —Nile-Congo Syndicate Promising—A Canadian Flotation.

BY W. A. DOMAN

London, April 4—Whether the name of the Great Boulder Proprietary will die out on the exhaustion of its West Australian property remains to be seen, but the directing power will apparently continue in some form or other. The management has sought for properties in other parts of the world, and not always with success. The latest venture is into Argentina, a nine-months' option having been obtained on a gold-bearing area in the province of La Rioja. The inducement to take up this option was presumably the report that values had been found ranging from 16 dwt. to 4 oz. of gold per ton. Engineers are being sent out to make the necessary investigation.

The annual report of the Rio Tinto company shows how seriously the reduction of trade the world over has interfered with the demand for the company's products, the sales for 1921 being not much more than half the pre-war figures. In the latter part of the year the demand increased slightly, but normal is not expected for many months to come. The price of standard copper was only £69 8s. 8d. against £97 12s. 4d. in 1920, and the balance sheet shows produce, shipped and afloat and remaining on hand in Great Britain and elsewhere, at cost as £578,923. If ore extracted and in course of local treatment and the partly manufactured copper in Spain, as well as mineral in open casts, be added, the total money laid out under these heads is £1,501,610. The British government has repaid to the company the amount of the 50,000,000 6 per cent peseta loan issued in 1918, but the company has not yet repaid it in Spain. It figures in the accounts at £1,768,960, and as a set-off the company has invested £836,053 in War Loan, and other securities and has £672,155 in cash. The company's creditors have been reduced from £1,435,463 to £643,761.

If matters should turn out as indicated, shareholders in the Tanganyika Concessions may receive an agreeable surprise. In November, 1920, the Nile-Congo Divide Syndicate was formed, with a capital of £35,000 in £1 shares, of which 20,000 shares are issued and fully paid. In this syndicate the Tanganyika Concessions and Zambesia Exploring Co. have each a 40 per cent interest. Prospecting has been done on the Sudanese side of the Divide, and according to information—very limited in extent—alluvial gold has been discovered in the river systems over an area of about 150 miles in length by about sixty miles wide. Investigations are still in progress, and it is reported that values have been secured as high as £2 per cu.yd., and, in addition, outcrops of copper-bearing ores have been found in several places over a considerable stretch of country.

Another big Canadian flotation has taken place—or is taking place, rather—on this side. The people behind it are A. Mitchelson & Co., Ltd., an outside firm of brokers, and a finance house. The property has been reported upon by Frank Loring, George Bent and Lieutenant Colonel Rowland C. Feilding. The last mentioned seems rather optimistic, for he estimates the quantity of ore disclosed by the work so far done in five levels, including probable ore, at 350,000 tons, averaging $11 per ton extractable value. He puts working costs at $4 per ton—which I believe is less than the Hollinger's costs—and takes the profit value of this ore at £500,000 at the normal rate of exchange. The market does not quite like the idea of "probable" ore being included, as the proportion of "probable" to actually developed is not stated. Judging by the information given in the prospectus, the property would seem to have good speculative chances, but it appears to be rather heavily capitalized. The authorized capital is £1,000,000, in £375,000 of preferred shares of 5s. and £625,000 in ordinary shares of 5s. The effect of the purchase consideration is apparently £50,000 in cash and £625,000 in shares. It is not easy to see exactly

how much money has been expended on the property, so that the vendors can net a nice little profit even if they sell at a pretty good discount.

CANADA

British Columbia

Boundary of Quesnelle Division Changed to Facilitate Claim Recording

Victoria—The provincial government, recognizing that there will be a rush to the Cedar Creek section of the Cariboo district as soon as the snow disappears, is taking steps to provide adequate facilities for the recording of placer or mineral claims. There is now a recorder at the 150 Mile House, Cariboo Road. The boundary of the present Quesnelle mining division has been extended a short distance southward to take in Williams Lake station, Pacific Great Eastern Ry. The mining recorder will be transferred from the 150 Mile House to this station. The change will permit him to carry out his duties as recorder for the Quesnelle division, wherein is Cedar Creek, and as sub-recorder for the Clinton division, in which is situated the Whitewater, with the maximum of convenience to the prospectors and mining men.

Greenwood—H. McGillvray and H. M. Stramberg have secured a three-year lease and bond on the Vendela, Hidden Load, and Silva claims, and are making preparations to work the property extensively this season.

Trail—Although the coal strike has extended to the Crow's Nest Pass coal fields, from which coke used at the Trail smelter is derived, no apprehension is felt that the smelter will experience an immediate shortage of coke, as the policy of the company has been to maintain a big stock on hand for such emergencies. Advices from the Crow's Nest section indicate that the strike is not likely to be prolonged.

Ore shipments received by the Consolidated smelter April 1 to 7 inclusive totaled 8,852 tons, of which 8,422 tons came from company mines. Other shippers were: Bell (Beaverdell), Beaverdell, 43 tons; Emerald, Salmo, 25; Horn Silver, Similkameen, 27; McAlister, Three Forks, 29; No. One, Sandon, 27; Renner & Drace, Ewings Ldg., 25; Rosebery Surprise, New Denver, 109; Silversmith, Sandon, 42; Silver Standard, New Hazelton, 31; Sally, Beaverdell, 39; Utica, Adamant, 33.

Ontario

Bailey Mine Closed—Merger of Teck-Hughes With Orr Sought

Cobalt—The annual report of the Beaver for the ten months ended Dec. 31, 1921, shows income of $31,538, and expenses of $22,523. The surplus shows a total of $944,500, of which $366,000 represents an investment in the Kirkland Lake Gold mine and bills receivable of $438,000, which apparently is money loaned to the Kirkland mine. The directors hold out the hope that operations may be resumed in a few months.

The crosscut from the 185 level of the Castle property, in Gowganda, has just cut the vein, which shows a width of 3 in., running as high as 3,000 oz.

During March Nipissing mined ore of an estimated net value of $172,747, and shipped bullion of an estimated net value of $362,441. No new veins were found, but development work on several small veins was encouraging. The low-grade mill treated 7,369 tons and the high-grade plant 152 tons. The refinery shipped 554,715 fine ounces of bullion.

Operations have been resumed on the Casey Mountain property.

The Bonsall claims in Gowganda have been acquired by the Miller-Lake O'Brien. The property comprises six claims adjoining the Castle-Trethewey.

The McKinley is dismantling the Savage property, removing everything except the pumps.

Coniagas has given up the claims in Larder Lake on which it held an option. On March 29 the company shipped seventy-two bars of bullion containing 73,000 oz.

For the three months ended March 31, 1922, La Rose produced 151,000 oz. of an estimated net value of $91,000. Revenue was somewhat smaller than for the corresponding period of last year, on account of lower exchange rates and lower payment for cobalt metal. Current assets, less liabilities, as of March 31, were $550,000.

The Bailey mine has been closed, but operations are being continued at the mill. The lease which this company held on the Silver Cliff has also been dropped.

Kirkland—The report of the Kirkland Lake Gold for the year ended Dec. 31 shows a production of $148,000 and income from exchange of $15,000, or a total of $163,000. Operating and administration costs were $150,000, showing an operating profit of $13,000, but this does not allow for interest on money borrowed. During the year the company treated 25,717 tons, of an average of $5.73 a ton, which is lower than that of any other operating gold mine in northern Ontario.

The Wright-Hargraves encountered a new vein while sinking the main shaft. It shows a width of about 6 ft. of $12 to $13 ore.

Financial arrangements are being made for the resumption of operations on the recently amalgamated Ontario and Montreal Kirkland.

The Tough Oakes mill has resumed operations after a shutdown since July, 1918. Recent developments on the property have been satisfactory.

Negotiations are proceeding for the amalgamation of the Teck-Hughes with the Orr property. It is understood that the main vein of the former property dips into the Orr at about 1,000 ft.

Porcupine—Dome's bullion output in March was valued at $312,000, as compared with $302,000 in February and $305,000 in January. It is understood that the directors will endeavor to maintain production at about this rate.

ARIZONA

Verde Central to Have Up-to-Date Plant—U. V. Extension Shipping 300 Tons Daily to Smelter

By James H. McClintock

Phoenix—The Tom Reed-United Eastern apex suit has been placed before the Supreme Court of Arizona, following argument on appeal from a decision favorable to the defendant in the Superior Court of Mohave County. It is the only apex suit that has come before the Arizona Supreme Court since 1883. It has novel features, one, in particular, involving the question whether a vein may be considered continuous despite a geologic fault that has separated the ends of the vein matter, in this instance a distance of 430 ft.

Argument before the Supreme Court on behalf of the Tom Reed was by William E. Colby, of San Francisco. John P. Gray, of Cœur d'Alene, Idaho, represented the United Eastern. The courtroom had been half filled with models of the mines and with map frames, used by the attorneys of both sides to demonstrate and illustrate their arguments.

The Arizona Commercial-Iron Cap suit was tried last December in Globe by Judge Sam. L. Pattee, of Tucson, but no decision has been announced.

Jerome—Gordon R. Campbell, head of the Calumet & Arizona, and a party of company officials have been inspecting the Verde Central and other local properties. It is said that authorization has been given the Verde Central management for purchase and installation of the best type of surface equipment, displacing inadequate machinery that has been retarding development. The C. & A. has option on 1,000,000 shares of Verde Central, which were contracted for at 70c. last summer.

United Verde Extension is employing a mine force of 250 men and is sending 300 tons of ore a day to the Clemenceau smelter. No increase in output is planned for the present.

The United Verde shovel operations are getting into the top of the hot sulphides.

No further action, it is said, will be taken in Prescott in the receivership application filed there by Charles H. Brown against the Calumet & Jerome Mining Co. and the Avery administration.

Mascot—Extensive diamond drilling will be conducted on the Central Copper Co.'s property this year. Work has already begun.

Mandy Mining Co. Reduces Capital

Reduction of the capital stock issued by the Mandy Mining Co. to 10,000 shares of common stock at $1 per share has been officially announced. The company owns the Mandy mine, in northern Manitoba. It is a subsidiary of the Tonopah Extension Mining Co., of Tonopah, Neb.

NEW MEXICO

Fluorspar Deposits Inspected by Illinois-Kentucky Operators—Coal Mines at Gallup Idle

From Our Special Correspondent

Bayard—A party of Illinois and Kentucky fluorspar producers made an inspection of the various fluorspar properties of New Mexico from April 3 to April 9, under the guidance of Alford Roos, a local fluorspar operator. In the party were J. M. Blaney and W. C. Bohn, respectively president and manager of the Fairview Fluorspar & Lead Co.; E. P. Hettinger, president of Hickman, Williams & Co., of Cincinnati; R. B. Ladoo, of the U. S. Bureau of Mines, and C. S. Nunn, representing the Kentucky Fluorspar Co. and Rosiclare Fluorspar Co.

It was determined that though fluorspar in a limited tonnage could be laid down in most instances at the railroad for less than was possible in the Illinois-Kentucky field, the New Mexican field as yet cannot offer serious competition, owing in part to the lack of development of the several mines, in a measure to the comparatively small size of the developed deposits and in part to the difficulties of transportation to railroad. Some of the mines, moreever, have unsolved metallurgical problems. It was also noted that without exception the New Mexican fluorspar mines were not sufficiently strong financially to carry on a protracted plan of proper development by which full justice could be done to the mines or to tide them over a lean period of economic stress, and that in fact production so far had been intermittent. Some of the properties had suffered keenly through losses incidental to irresponsible brokers handling their product.

Gallup—Organizers are making an effort to unionize the coal miners in this district. They are claiming everything but the indications do not point to complete success. All the mines are shut down. There are about 900 miners in this field. It is confidently predicted by operators that at least 40 per cent of the men will be working soon.

Santa Rita—New men are being put to work by the Chino Copper Co. in both mine and mill as needed. Labor to meet present requirements is available.

Tyrone—The Leeches, who have been experimenting in concentrating torbernite ores from the White Signal district, are meeting with sufficient success to warrant the hope that a process may be perfected that will have a commercial application. This is of particular interest on account of its novelty, there being no process known at present that is successful for this purpose. Recent prospecting has considerably extended the area over which this mineral is found.

Chloride—The annual meeting of the Silver Mountain Metals Co. was held on April 3 in El Paso. The following officers were elected: John M. McCutcheon, president and general manager; G. D. Walters, vice-president; J. M. McCutcheon, Jr., secretary.

CALIFORNIA

Movement to Organize National Silver League Under Way — Opinion Regarding Denison Bill Not Definite

San Francisco Correspondence

San Francisco—Of interest to silver miners of the West is the recent move to organize the National Silver League. Preliminary meetings were held on April 1 and 6 in San Francisco. The purpose of the league is to re-establish silver as a money metal. Efforts are to be made to secure international action to stabilize the value ratio at 15½ of silver to 1 of gold and to further a bimetallic monetary standard. Frank H. Norcross, of Reno, Nev., was elected president. Plans are under consideration to hold a convention in San Francisco in June.

The Commissioner of Corporations, E. M. Daugherty, is urging bankers, brokers, civic organizations, and investment associations to support the Denison bill, but local opinion among mining men here apparently has not crystallized. Opinion where expressed is adverse, but this may be due to a concerted drive by "interests" opposed to this bill rather than the result of careful consideration of its provisions.

Northern California gold-mining districts continue to report increasing activity. The Lorenz hydraulic mine, near Weaverville, has five grants in operation. The Sybil mine, at French Gulch, reports its March clean-up at approximately $8,000.

In north central California, the Grass Valley district continues normal operation. From Quincy it is reported that the Jamison mine, at Sierra City, contains enough low-grade ore to operate steadily. The Emigrant Hill gravel mine, at Elizabethtown, has been reopened, and nine men are employed. Judson M. Coats is in charge of the operations. Some development work is to be undertaken in the old Meadow Lake district. An attempt to rob the mills at Grass Valley was nipped in the bud, and the alleged conspirators have been jailed.

The Mother Lode region shows increased activity. The Tonopah Mining Co. of Nevada is completing preparations for work on the Chileno. The old Thorpe mine, between San Andreas and Angels Camp, was recently bonded and will be reopened.

The Darwin Silver Co., in Darwin, Inyo County, is starting up its pilot mill, but operations will be restricted.

OREGON

Bayhorse Mine Makes First Shipment

Huntington—The first shipments from the Bay Horse mine were made the latter part of March by the U. S. Metals Co., which has had the property under development for several months. One car was sent to Salt Lake for testing, and a second was billed to Tacoma, the plans of the company being to ship about a car a day after a marketing point is decided upon. Values are in silver.

NEVADA

Candelaria Active—West End Breaks Tonnage Record—Tonopah's March Output Above Normal

From Our Special Correspondent

Candelaria—The camp of Candelaria shows activity. Construction of the 300-ton plant of the Candelaria Mines Co. is progressing satisfactorily. The power line from Mina to Candelaria has been started and an 800-hp. substation will be built at Candelaria. The old pipe line from Mount Montgomery, about twenty-five miles long, is being repaired, and a railroad spur being built. The Northern Belle mine was carefully sampled in 1919, and it is estimated that 600,000 tons of ore is available which will run between 10 and 15 oz. of silver per ton. The Lucky Hill mine has been taken over by the Candelaria Mines Co.

Hawthorne—A lease syndicate, composed of mining men from Tonopah, Hawthorne, and Virginia City, is operating from the tunnel level of the Lucky Boy mine, about 6,000 ft. from the portal. A shaft is down 40 ft., and shows some rich ore. The stopes above the tunnel contain variable widths of high-grade ore, which is being taken out and sacked for shipment. The Lucky Boy mine is famous for its lenses of high-grade ore, one of which produced over 1,000,000 oz. of silver. Values are mostly in silver, with some lead.

Tonopah—The March production of this district was approximately $650,000, or about $50,000 above normal. Recent bullion shipments from the district, representing the clean-up of operations for the latter half of March, were as follows: Tonopah Belmont, $131,842; West End, $95,000; Tonopah Extension, $74,000; Tonopah Mining, $40,000.

The Tonopah Extension Co. produced 11,535 tons of ore during March, which is a new record for this company. Conditions on the 1,880 level are reported as being satisfactory. The Tonopah Belmont accomplished the usual development on all levels, from the 600 to the 1,400, with nothing new of importance.

West End's tonnage in March was 8,400, which is the largest ever mined by the company. The Midway reports an interesting discovery in an old working on the 1,200 level about 150 ft. northwest of the new shaft. It appears that development work was discontinued in this particular working several years ago without a realization of the existence of commercial values. The vein is about 8 ft. wide.

Goldfield—About 550 tons of $57 ore was shipped from the Silver Pick lease on the Red Top during March. The last two cars averaged $95 per ton. The stope looks promising. The ore is typical Goldfield ore, spotted and difficult to sample, and its extent is indeterminate. Goldfield mining men state

that it is the most important Goldfield discovery since the Jumbo Extension bonanza.

Hornsilver—Favorable developments continue at the Orleans Hornsilver. The Northeast drift on the 700 level is following 4 ft. of $35 ore and the southwest drift on the same level is in commercial ore. Development has been temporarily suspended on the fifth and sixth levels. There is a noticeable decrease in silver values on the 700 level southwest, with a noticeable increase in gold values.

Ely—Milling operations recently resumed by the Nevada Consolidated at McGill lasted two weeks, the non-arrival of coal causing a quick shutdown. Men working at the mill have been transferred elsewhere. Similarly, miners at the Ruth mine have been placed on development until the situation shows improvement.

Operations in the Pioche District

By E. C. D. Marriage

Pioche — Operations continue on a steady scale at both the Bristol and Jackrabbit, with slightly more ore being moved. The grade of this product is of higher value, due to cleaner mining.

The Virginia Louise mine, adjoining the Prince, should benefit by the improved smelter situation, and the large ore reserves should soon be again in demand. The average analysis of the tonnage available is approximately: Gold, 0.01 oz.; silver, 2.6 oz.; lead, 3.4 per cent; iron, 34.6 per cent; manganese, 11.5 per cent; insoluble, 8.6 per cent; lime, 3.1 per cent; zinc, 1.8 per cent; and sulphur, 0.2 per cent.

Settlement was received this week on car lots from the Mascot and Alps mines, east of Pioche. The Alps settlement showed $2.50 in gold, 135.9 oz. in silver, and 52.0 per cent in lead. The Mascot averaging $6 in gold, 67.0 oz. in silver, and 19 per cent in lead for the thirty-eight tons shipped.

Shipments from the district for the week ended April 14 were as follows: Black Metals, 340 tons; Bristol Silver, 275; and Mendha mine, 50.

Canal for Iron-Ore Carriers Favored

In a letter to the Great Lakes, St. Lawrence Tidewater Association, E. G Grace, president of the Bethlehem Steel Co., especially emphasizes the fact that the Great Lakes-St. Lawrence canal project would be of great benefit to the steel industry. Mr. Grace, wrote in part as follows:

"The question of building ore-carrying ships for ocean service presents no difficult problems, as our experience has taught us in the fleet which we are operating between Cuba and the United States. It would seem that the transportation of ore from the upper Lakes to the seaboard ports in vessels should be considerably cheaper than the part-vessel and part-railroad method which is now necessary."

MONTANA

Forces Increased at Washoe Smelter —New Ore Cut in Katie Mine at Basin

By A. B. Keith

Butte—The East Butte's gold cyanide mill at Elkhorn, Jefferson County, where operations were begun last November, reached a self-supporting stage by the end of 1921, according to the comment of Robert H. Gross, president, in the annual statement. In the company's oil operations nothing was done beyond operating gas wells in Marion County, Kan., where the wells have no market beyond the requirements of neighboring oil fields, and this output is limited.

The Tuolumne Copper Mining Co. is continuing sinking of its Main Range shaft, which is now below the 1,900 level. By the middle of May it is thought that it will be possible to crosscut to the Spread Delight at that depth. Sinking will continue to the 2,400 level and this vein will be cut again.

The Black Rock concentrator of the Butte & Superior is now at capacity with ore production from the Black Rock mine at approximately 1,000 tons daily.

Basin—Cutting of a vein said to be 2 ft. wide on the 400 level of the old Katie mine has again called attention to this property. Assays of gold ore are reported to be high. In the early operations of the Katie it was necessary to search the miners to prevent "high grading." About half a hundred men are now employed at this mine.

Anaconda — Forces at Anaconda's Washoe smelting works have been increased by about 350 men, and an additional furnace has been fired, in connection with the resumption of the work of reclaiming the values from the old tailings pile.

IDAHO

Coeur d'Alene District

Hecla's Annual Meeting Held at Spokane

The annual general meeting of the stockholders of the Hecla Mining Co. was held at the Empire State Building, Spokane, on April 11. The regular quarterly dividend of $150,000, payable, June 28, was declared, and deeper development was authorized of the Wide West claim, which was acquired from the Federal Mining & Smelting Co. at the time the settlement of the Marsh Mines Consolidated apex litigation was effected. The only one change was made in the board of directors, George P. Mayer, of Milwaukee, succeeding Mrs. Sarah Smith, who is reputed to hold the largest individual amount of Hecla stock and who was one of the plaintiffs in the litigation started last year by a minority faction to prevent ratification of an agreement whereby the Hecla and Bunker Hill & Sullivan companies entered into a joint partnnership in the Sullivan Mining Co. for development and operation of the Star property near Mullen, Idaho.

Mr. Mayer is vice-president of the National Bank of Commerce and president of the F. Mayer Boot & Shoe Co., of Milwaukee, and president of the Washington Boot & Shoe Co., of Seattle. The Hecla board is now made up as follows: James F. McCarthy, Wallace, president; W. J. C. Wakefield, Spokane, vice-president; Frank J. Kipp, Carl Landsee, and George P. Mayer, Milwaukee; E. J. Nolan, Los Angeles, and Dr. H. C. Lambach, Spokane.

Other Districts

Copeland—Readjustments are being made to the mill of Idaho Continental mine and flotation equipment has been added, the work being undertaken under direction of Bunker Hill metallurgists following a series of tests extending over several months. It is expected that milling will be resumed early this spring. Work is being continued steadily on the driving of the lower tunnel, which will open up the mine 350 ft. below the levels hitherto worked. Operations are being conducted under a five-year lease held jointly by A. Klockmann and the Bunker Hill & Sullivan Mining and Concentrating Co.

Bonners Ferry—The Cynide Gold Co. ("Cynide" is the legal spelling, on account of incorporation error in spelling) has concluded arrangements for building a 100-ton cyanide mill. The property is twenty-four miles northeast of Bonners Ferry, and values are in a finely disseminated gold, which has hitherto resisted all methods of extraction. Recent cyaniding tests have given a 92 per cent saving.

Adair—Arrangements have been completed whereby the Richmond Mining, Milling & Reduction Co., with holdings in the Idaho-Montana copper belt, near Saltese, will have an easement on the long tunnel of Montana-Idaho Copper Co. The Montana-Idaho crosscut is now only a few hundred feet from its objective. The Richmond will have to drive about 1,200 ft. from the Montana-Idaho tunnel to cut the vein sought, and will then have a vertical depth of about 1,700 ft.

UTAH

U. S. Company to Open Bingham Properties at Greater Depth— High-Grade Cut in Ontario

From Our Special Correspondent

Bingham Canyon—The United States Mining Co.'s Bingham properties, according to the company's report are to be opened 1,100 ft. below the Niagara or main transportation tunnel level, to a depth 900 ft. greater than any so far attained. During 1921 the Bingham Mines, including the Niagara Mining Co., shipped an aggregate of 151,450 wet tons of complex gold, silver, lead, zinc, ore, compared with 102,842 wet tons the year preceding. In addition, 9,547 wet tons of copper ore was shipped. Development at lower levels has been productive, both in tonnage and in average value, of the com-

plex ore, and a large part of the output of copper ore came from this part of the mine. The concentrator at Midvale, milled 138,771 tons of crude ore of average grade in comparison with 106,874 tons for the preceding year. The lead smelter treated 187,192 tons of marginal ore as against 215,757 tons in 1920, the reduced tonnage being accounted for by reason of curtailment of custom ore shipments, due to the low price of lead in comparison with its production cost. The lead bullion output for the year amounted to 27,160 tons, or slightly less than in 1920. By-products, including arsenic and arsenical compounds, were recovered or manufactured into marketable forms, and this business is growing, providing an avenue for the consumption of one of the by-products of the ores.

The Montana-Bingham received a gross income of $43,556 from the sale of copper fluxing ore during 1921. The ore came from the Mayflower of the company's Fortuna holdings, which could be worked economically from the Montana-Bingham tunnel. A net deficit of $50,805 was shown.

Alta—The Columbus-Rexall has just paid its second dividend, amounting to $17,567 or 3c. a share. There is a substantial surplus in the treasury. The bins are full, and as soon as the roads are opened ore will be marketed for some time. Enough ore is reported to be developed to maintain profitable shipments for a considerable period.

Park City—Ore shipments for the week ended April 8 totaled 2,179 tons, as compared with 2,285 tons the week before. The shippers were Judge Allied Companies, 1,082 tons; Silver King Coalition, 586; Ontario, 511.

High-grade silver ore has been opened in the old Ontario mine on the east side of a porphyry dike and fault, which in the early days was thought to limit the ore on the east. The discovery was made in a raise above the 1,300 level, and two shipments from this ore had been made.

Eureka—Ore shipments from the Tintic district for the week ended April 8 amounted to 151 cars of ore, compared with 152 in the week preceding. Shippers were: Chief Consolidated, 42 cars; Tintic Standard, 36; Eagle & Blue Bell, 15; Colorado, 14; Iron Blossom, 12; Victoria, 9; Dragon, 5; Centennial-Eureka, 4; Grand Central, 4; Gemini, 3; Alaska, 2; Swansea, 2; Eureka Hill, 1; Sunbeam, 1; Eureka Mines, 1.

At the Grand Central, repairs have been completed on the tramway and shipments have been resumed. A number of improvements are being made at the shaft and at the upper terminal of the tramway. About 100 leasers are working at present.

26 Fatalities in Arizona

Despite inactivity in the larger mines of Arizona during 1922, twenty-six fatal mine accidents were reported during the year to the State Mine Inspector.

COLORADO

Reported Camp Bird Will Resume Development This Year

From Our Special Correspondent

Ouray—It is stated on good authority that the Camp Bird will resume operations this summer, probably next August. The new work will be a resumption of development in the west heading of the main drift on the vein at the level of the new crosscut tunnel. Good ore had begun to show here when work was stopped over two years ago.

Work has been resumed at the Black Girl, just north of Ouray, by leasers working under Fred Herzinger, of Ouray. Shipping ore of good grade in silver is produced by this mine, which has been idle ever since the rise in freight and treatment rates.

The Ouray Leasing Co. has struck high-grade gold ore in the lower adit of the Barstow, where it has been drifting all winter. A good shoot of milling ore has already been developed, and the high-grade free-gold ore now found will probably develop another of the rich shoots which have made the mine well known.

It is publicly announced that the owners of both the Revenue and Governor, well-known mines which have been idle for years, will let contracts for driving tunnels on their main veins this summer, the work aggregating 1,000 to 2,000 ft. of drifting.

Telluride—Shipments of concentrates from the Telluride district in March were 154 cars, compared with 114 cars in March, 1921. Smuggler Union shipped 102 cars and Tomboy 52. This compares with 143 cars in January this year.

Alma—The London Gold Mines Co. has completed its raise and made connections from its new lower tunnel with the Extension workings, and has a force of men enlarging and retimbering the latter. This tunnel, when completed, will open the veins at a point approximately 500 ft. below the South London workings.

Work has been resumed at the Hock Hocking property in Mosquito Gulch. The present workings will be extended a distance of 600 ft.

The Associated Mines Co., operating the Champaign property in North Mosquito Gulch, made its initial shipment of high-grade silver ore to the A. V. smelter in Leadville last week.

Breckenridge—The property of the Gold Bond Exploration Co. is being developed under lease. A 2-ft. vein of high-grade silver ore has been opened.

Kokomo—The Silver Queen property is being developed and operated by a leasing company, and six carloads of silver-bearing ore are shipped monthly to the Arkansas Valley plant of the A. S. & R. Co. at Leadville.

Alma—George W. Logan has closed a deal on his Hock-Hocking mine at Alma to local investors, who have put up a fund of $15,000 to extend the present tunnel on the vein 1,100 ft. to the end line of the property, with the option of purchasing at $175,000.

MICHIGAN

The Copper Country

Isle Royale Mill Started—Coal Stocks Sufficient—Mayflower Seeking Lode from 1,700 Level

BY M. W. YOUNGS

Houghton—Only 2,000 tons of "rock" is being shipped daily from the Calumet & Hecla conglomerate department to the Calumet mill, where six heads are in operation sixteen out of the twenty-four hours. If there is no decrease in the high yield obtained during the first three months of 1921, this tonnage will give 1,887,000 lb. of refined copper per month, which is only 30 per cent of normal for the entire mine in average years.

Isle Royale's stamp mill was started April 10 with its battery of three heads. Tonnage from the mine will be at the rate of 1,000 tons daily for the entire week, but the mill will run only four days a week. The mill, however, will treat 1,500 tons of rock every twenty-four hours of the short week, equivalent to 1,000 tons daily for a full week. Based on the yield recovered during the three months the mine was operated in 1921, Isle Royale will produce at the rate of 534,250 lb. of refined copper per month, or 46 per cent of normal.

Shipments from Ahmeek average 1,500 tons daily, which will yield, based on 1921 recovery, 1,105,000 lb. of copper per month. This is at the rate of 83 per cent of normal.

The coal strike situation is not regarded as serious here. The docks are usually restocked early in the season, the first coal boats arriving soon after the opening of navigation the latter part of April. Some of the mining companies have been purchasing their coal for several years from non-union mines, and last summer one of these four bought 15,000 tons in excess of needs, expecting a coal strike at this time. No fear is felt that the docks will not be completely stocked and that the mines will be able to continue operations next winter. The reduced scale of operations also will help considerably.

A new engine house has been completed at No. 2 Gratiot shaft, Seneca. The new hoist, which is on the ground, will not be needed, however, for some time, or, at least, until sinking is resumed from the thirteenth level. The work of cleaning out the shaft and straightening it to conform to the dip of the lode has been completed to the ninth level. The shaft will be deepened to a depth of 3,200 ft., at which point contact will be established with the third level drift from the Seneca shaft. Other openings from Seneca also are being pushed toward Gratiot ground, and connection with the Gratiot shaft will be necessary to establish ventilation. There are already over 8,000 ft. of openings in the Seneca and Gratiot.

Quincy continues to operate its new furnace at its smelter. It is the largest and most modern furnace unit in the

district and most economical in operation. Its capacity is 250,000 lb. of copper daily, but is not, of course, being worked at capacity under present market conditions. Quincy is now on a production basis of about 1,000,000 lb. of refined copper per month.

In hope of re-establishing contact with the lode, the Mayflower-Old Colony has begun work on a raise in the crosscut on the 1,700 level. Drifting continues south on the 1,450 level, but the rock at present is barren of values.

Gogebic Range

Townsite Mine To Resume Production Soon—Improving Power Service—Unique Compensation Decision

Ironwood—The Townsite mine is being put in condition for operation as rapidly as possible. It will be ready, it is thought, by May 15. About 125 men will then be employed, and it is planned to continue operation at capacity throughout the season.

Some improvements have been made in the public service electric system which supplies power to most of the mines and all of the towns on the range. It is understood that work on the water-power project on the Flambeau River will be renewed. It will develop about 15,000 hp.

A survey of the power conditions as to supply and demand on the Gogebic Range was made a short time ago by H. M. Byllesby & Co. for a syndicate controlling about 25,000 hp. water-power on the Sturgeon River near Sidnaw, Mich. On account of difficulties of development, however, this power will probably not be made available at present. It is situated nearer to the Marquette Range than to the Gogebic.

In a workman's compensation case which was appealed from the Michigan state labor commission to the Michigan Supreme Court, the award of the commission granting compensation to the heirs of a workman who apparently died from the shock of seeing another man injured in an accident was upheld by the court. The workman who died dropped a tool which struck the other man, causing the accident. The case was Klein vs. Len H. Darling Co.

MINNESOTA

Cuyuna Range

Kennedy Mine Will Reopen at Once—Hillcrest Shipping—Inland Steel Sending Ore to Docks

Cuyuna—Officials of the Rogers-Brown Ore Co. have received orders for the immediate reopening of the Kennedy mine. The mine normally employs about 175 men.

Ironton—First ore shipments to the docks for the Cuyuna Range were begun April 11 by the Inland Steel Co. from its Armour No. 2 mine. It is planned to ship four cargoes approximating 50,000 tons from this property before May 1. The mine has been idle since March 1, but is expected to resume operation in the next two weeks.

A petition asking for the vacating of a part of the platted area of the village of Ironton has been filed in the district court at Brainerd by Winona Kreitter and the Lamb Estate, Inc., fee owners of the Ironton mine.

Shipments from the Hillcrest mine (Coates & Tweed) were begun on April 18. Ore production will be rushed to meet the schedule of three boats reported for Hillcrest ore before May 15. One shovel is also busy on stripping at this pit. The new drainage shaft has been completed to a depth of 160 feet. A drainage drift is being driven across the formation at this level, and foundations are being placed for a 400-gal. Pomona deep-well pump.

An all-rail shipment to a St. Louis furnace has been made from the Huntington mine of the George H. Crosby interests. The property has been idle since early in 1919, and the recent shipment is the first from its stockpile.

Trommald—The Maroco mine of the Marquette Ore Co. has been reopened, and steam shovel and hydraulic stripping have been resumed to put the pit in condition for ore production this season.

Riverton—Bids were recently considered by the John A. Savage Co. for the furnishing of all conveying equipment for its drying plant at the Sagamore mine. A drag-line shovel is being used to dig an approach from the pit to the plant. Extension of ore reserves to the northwest of the present pit is being tested with diamond drills.

Mesabi Range

Laura Mine Resumes—Iron Ore Situation Brighter

Hibbing—The Laura mine (Inland Steel Co.) has resumed with 150 men.

The whole iron-ore situation in this district looks brighter, although there are many idle mines. It is anticipated that word will be received in the near future for resumption by many of the properties. The opening of navigation according to the present outlook will be around April 25, but prior to this date shipments will be made from the mines on the range which will be held in storage until boats are able to break through the ice.

Virginia—Mine rescue car No. 10, with headquarters at Houghton, Mich., and in charge of R. V. Ageton, is now on the Mesabi range, and will not complete its itinerary until the middle of June.

Biwabik—The Biwabik Mining Co., which operates the Biwabik open pit, has started repairs on its equipment preparatory to ore operations in its pit this season.

Chisholm—The Frazier open pit, (Oliver Iron Mining Co.) has been forced to close temporarily because of water and the soft ground around the dumps.

Keewatin—Loading of ore from stockpile has been started at the Sargent mine, a property of the Wisconsin Steel Co.

ALABAMA

Iron Making Increasing—District Aided by Coal Strike Elsewhere — Rock Asphalt Company Formed

By George Huntington Clark

Birmingham—The record of Alabama iron making during the first ten days of April continues to show regular and steady progress toward normal output of pig iron.

Blast furnace No. 3 of the Sloss-Sheffield Steel & Iron Company's plant at North Birmingham, which was overhauled during the last year, has been blown in.

As expected, the bituminous coal strike has not been participated in by the Alabama coal miners, only one mine having been adversely affected. On the contrary, the strike has stimulated coal production, which is responding to the demands for fuel supply received from outside districts. A material decrease in the district's unemployment is indicated, by reason of augmented shifts at the mines.

Mining industries in Alabama, not related to iron and steel making, show as yet little recovery from the war-induced stagnation.

The unfortunate deadlock in Congress over the utilization of the nitrate plant and other projected industries at Muscle Shoals has held up many mining operations already planned and dependent on the anticipated and ultimately assured manufacturing center there. Mention was recently made of the interest attracted to Alabama deposits of rock asphalt apparently suited to the surfacing of heavy-traffic main highways, which are necessary in this state on roads leading out from manufacturing centers.

The first evidence of definite action toward the mining and preparation of Alabama rock asphalts (recently mentioned), is seen in the incorporation, just announced, of the Muscle Shoals Asphalt Co., in Franklin County, owning 3,000 acres of asphalt deposits. The officers of the company are C. E. Dexter, president; W. J. Borries, chief engineer; C. J. Stillers, construction engineer—all of Louisville, Ken.—and S. M. Hills, of Indiana, in charge of quarry operation. W. S. Douglas, of Russellville, Ala., is local superintendent. The property purchased is near Littleville, in Colbert County.

JOPLIN-MIAMI DISTRICT

Federal Mine at Picher, Okla., Reopened After Two Years Idleness

Picher—After an idleness of over two years, the Federal mine, in the south part of the town of Picher, Okla., was opened up by the S. R. & W. Mining Co. early in April. The lease of the new company was formally approved by the Interior Department at Washington some weeks ago, and operations were started as soon as possible thereafter, with Homer Seals as general superintendent and J. W. Roberts as secretary-treasurer of the company.

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
13	12.625	30.25	31.00	5.00@5.15	4.90	4.90
14	12.625	30.25	31.00	5.00@5.20	4.90@4.95	4.90
15	12.625	30.25	31.00	5.00@5.20	4.90@4.95	4.90
17	12.625	30.00	30.875	5.00@5.20	4.95	4.90
18	12.625	30.00	31.125	5.00@5.25	4.95@4.975	4.90
19	12.625	29.75	30.75	5 00@5.25	4.95@4.975	4.90

*These prices correspond to the following quotations for copper delivered: 12.875c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
13	59¼	59⅞	64½	151½	153	22¾	22¼	26⅝	26⅝
14	...	...	...	....	....	...	...	...	...
15	...	...	...	....	....	...	...	...	...
17	...	...	...	....	....	...	...	...	...
18	59	59⅝	64½	152¾	154	22¾	22¼	26¼	26¾
19	58¾	59⅜	64	151¼	153⅛	22⅞	22⅜	26⅞	27

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
13	441	99⅝	65½	33⅜	17	441½	99⅝	65⅜	...
14	441	99⅝	65⅝	...	18	441½	99⅝	66	33⅝
15	441	99⅝	65⅜	...	19	441½	99⅝	70	35⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, April 19, 1922

The metal markets have been quieter than usual during the last week, largely in consequence of Easter. The New York Stock Exchange was closed on Good Friday, and trading in the metals was also practically at a standstill. Copper, tin, and zinc prices are virtually unchanged today from the levels ruling a week ago. Lead is slightly firmer. The feature of the week was the sudden advance in the price of silver in London today, the price being 35⅞d. compared with 33⅝d. yesterday. The exact reason is unknown, but is thought to be a sudden demand from China caused by revolutionary movements there, some of the natives wishing to transfer their resources into metal.

Copper

Copper is unchanged in price from last week, and much the same marketing conditions also obtain. The general basis of quotation and sale has been 12¾c. delivered during the second quarter, and 13@13⅛c. for the third quarter by those producers willing to go so far ahead. No large orders are reported, but some of the companies have been able to do a small business each day at this level. The last three days efforts have again been made by more than one interest to market large blocks of copper at 12.75c. delivered to particularly desirable consumers so situated as to take a low freight rate. But little of this business was accepted, however, consumers preferring to remain aloof for the time being. In no case, it is believed, would these offers have netted producers as low as 12.50c. It is said that wire-drawers have a large amount of business in prospect, and the metal continues to go well into consumption.

The export market has been quiet, owing to the Easter holidays, which are more generally observed in Europe than here. Sales have in general been at about 13⅛c. c.i.f., thus netting producers in this country better prices than were obtained for domestic deliveries.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5c., New York.

Sales have been in smaller volume during the last week, but this has not been because of lack of demand; rather have producers been indisposed to contract for the sale of any more April metal, their supplies being sold out. This condition has served to magnify the spot demand. Supplies in the Middle West continue ample, and almost any amount of lead could be obtained there at the prices which we quote. Delivery in New York, however, would cost 35c. per 100 lb. more, thus bringing the price up to about 5.30c. on lead shipped from St. Louis—a somewhat higher figure than the market has yet reached. Regular customers of the large producers are still obtaining their customary requirements of lead at or near 5c. Other business is considerably higher, and deliveries inside of thirty days can hardly be obtained today for less than 5.25c; in fact, one producer reports turning down a bid for 300 tons at that price yesterday. May lead is obtainable at about 5.15c. Some bonded lead is going to Europe.

The lead market has got away from the producers. The speculative demand from consumers is partly responsible, but actual consumption is also better, a large amount of lead going into building materials, storage batteries, and particularly into paint. It is to be hoped that the price is not forced up to such a point that a violent reaction will occur. Several mines are reported reopening.

Zinc

Sales of zinc have been unusually brisk, but at generally unchanged prices, on the basis of 4.90c., East St. Louis. A large proportion of the inquiries from consumers, and the sales actually negotiated, were for May delivery, which commanded a 5-point premium. The coal strike has been a

damper upon more active demand from galvanizers and is probably responsible for the steadiness in price and the failure of the market to advance. The statistics issued by the American Zinc Institute, as finally revised, show a decrease in stocks of 3,862 tons. Stocks on hand March 1 were 64,124 tons; production for March was 26,532; shipments were 30,394; and stocks on hand March 31, 60,262. Average number of retorts operating during the month, 44,369. Stocks are now only sufficient for two months' supply of metal and the statistical position is much improved over that of last fall. New York prices rule at the customary advance of 35 points over the St. Louis level. High-grade zinc sales have been excellent at unchanged prices of 6c., with 30c. per 100 lb. freight allowance.

Tin

The demand for tin has been quiet since the price advance, but yesterday and today there was evidence that consumers are getting accustomed to the present level, as the market was somewhat more active. Offerings of Chinese tin, and later of English tin of 99 per cent grade, which arrived here unsold, have depressed the price of the lower grade until yesterday it was possible to obtain it at more than 1 cent discount from the price of Straits. Tin for forward delivery has in general been obtainable at the same price as that asked for spot, though a premium of one-eighth cent has been realized in some sales.

Arrivals of tin, in long tons: April 15th, Straits, 110; 17th, London, 50; Straits, 15; 18th, Liverpool, 205.

Gold

Gold in London: April 18th, 93s. 4d.; 19th, 93s. 6d.

Silver

The market has been quiet during the Easter holiday period, but on the 19th advanced sharply to 35⅞d. in London and 70c. in New York on heavy buying by China. The tendency at the close is uncertain.

Mexican Dollars—April 13th, 50⅝; 14th, 50¼; 15th, 50¼; 17th, 50¼; 18th, 50⅝; 19th, 53⅞.

Foreign Exchange

European political developments have affected exchanges somewhat during the week, but no important changes have resulted. On Tuesday, April 18, francs were 9.265c.; lire, 5.43c.; marks, 0.34125c.; and Canadian dollars, 97.69c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5c. for the week. Market active and firm.

W.C.C. brand, 5½@6c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—6.75@7c. per lb. Slight improvement in demand.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 36; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$51 per 75-lb. flask. San Francisco wires $50. Firm.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of April 8.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, Titanium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of April 8.

Zinc and Lead Ore Markets

Joplin, Mo., April 15—Zinc blende, per ton, high, $31.40; basis 60 per cent zinc, premium, $31; Prime Western, $30@$29; fines and slimes, $28@$26; average settling price, all grades of blende, $27.07.

Lead, high, $69.05; basis 80 per cent lead, $69@$70; average settling price, all grades of lead, $66.32 per ton.

Shipments for the week: Blende, 9,027; lead, 1,758 tons. Value, all ores the week, $360,970.

Producers of zinc ore authorized a 10 per cent wage advancement and held for a $30 basis this week, with the result that premium ore commanded $31 basis and some sales of Prime Western were made on $30 basis, though the bulk of these sales were made on $29 basis. Purchases this month have exceeded the output, and when shipped out will materially reduce the reserve stock of zinc ore. The high price of lead ore is causing many owners to turn their mine production to that mineral as largely as possible, with a tendency to restrict rather than increase the production of blende. Lead prices for next week's market were not given out today, the quotation given being reported as the probable market.

Platteville, Wis., April 15—Blende, basis 60 per cent zinc, $29 to $30. Lead ore, basis 80 per cent lead, $67.50 per ton. Shipments for the week: Blende, 583; lead ore, 40 tons. Shipments for the year: Blende, 4,607; lead ore, 720 tons. Shipped during the week to separating plants, 424 tons blende.

Non-Metallic Minerals

Prices are unchanged from those in the issue of April 8, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc.**

Mineral Products

The prices of **Copper Sulphate, Sodium Nitrate, Potassium Sulphate** and **Sodium Sulphate** are unchanged from the issue of April 8.

Ferro-Alloys

Ferromanganese — Domestic prices have advanced $5 to $67@$69, f.o.b. furnace.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferrovanadium** and **Ferro-uranium** are unchanged from the issue of April 8.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Zinc Sheets,** and **Yellow Metal** are unchanged from the issue of April 8.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of April 8.

The Iron Trade

Pittsburgh, April 18, 1922

Strikes in the Connellsville and lower Connellsville region have increased somewhat in the last week, the coke output being reduced by more than one-half and the output in coal shipped by a still greater proportion. A few furnaces have had to be banked.

The steel interests are making strong efforts to maintain production. Buyers of steel have stocked up to an extent in anticipation of the coal strike and in general there is no particularly urgent call for deliveries. With the heavy buying of late, the steel market in general is quieter, with prices well maintained and showing some advancing tendency. The 10c. advance in nails, to $2.50, has been made by all independents, but the leading interest has not acted. A little sheet business is already being booked at the prices as recently advanced $2 a ton. Bars, shapes, and plates remain quotable at 1.50c., with possibly an occasional concession on a particularly desirable order.

Pig Iron—Most of the furnaces have withdrawn from the market, on account of Connellsville coke supplies being so largely shut off. There is no precisely defined market, but Valley prices are not under $21 for bessemer, $20 for basic, and $21 for foundry, making $1.50 advance in bessemer and $2 advance in basic and foundry in the fortnight. A sale of 1,000 tons of basic is reported at $20, Valley.

Coke

Connellsville—Furnace, $3.50; foundry, $4.25@$4.75.

Many More Copper Companies Resume Operations

By Felix Edgar Wormser
Assistant Editor, *Engineering and Mining Journal-Press*

ONLY A FEW COPPER COMPANIES in the United States now remain closed. Generally they are the smaller producers. The four porphyry copper companies—Utah, Ray Consolidated, Chino, and Nevada Consolidated—comprise the last great group to announce resumption—the most important development in the copper market since the merger of Anaconda Copper Mining Co. and American Brass Co. They will not be able to produce much marketable copper before July, and if the domestic and foreign industrial situation improves by that time, their action will have justified itself, but overproduction would be a misfortune. Much market and industrial history has been made since they closed down. Although the porphyry coppers had unusually heavy stocks of copper in their possession at the beginning of 1921, they have disposed of a large amount of the metal during the various buying movements in the last year. Most of their present stocks will be absorbed by agreements with the Copper Export Association, and are available only for export business, so that, so far as domestic trade is concerned, a shortage of copper is a serious possibility.

The porphyries profited greatly by the financing of surplus stocks early in 1921 and collectively accounted for over 20 per cent of the 400,000,000 lb. set aside for export purposes. Strong financially, and with a common sales agency, they have been able to adopt an independent attitude in the market consistent with their views of the copper situation. While other companies have continued operations and some have but recently resumed, the porphyries have refrained from taking any step which would jeopardize the welfare of the industry. They have probably done more to improve the position of copper than any other group of producers, and deserve great credit for the rôle they have taken.

Now that the most trying period of the industry is behind them, they courageously believe that business conditions warrant, or will warrant within the next three months, a greater production of copper, and they are the last important group to resume operations. A list of the active companies follows:

Anaconda Copper Mining Co.
Phelps Dodge Corporation.
Calumet & Hecla and subsidiaries.
Copper Range, Quincy, Mohawk, Wolverine.
Old Dominion Copper & Smelting Co.
Inspiration Consolidated Copper Co.
Miami Copper Co.
Calumet & Arizona Mining Co.
New Cornelia Mining Co.
United Verde Extension Mining Co.
American Smelting & Refining Co. (Custom smelting.)
Tennessee Copper & Chemical Corporation.
Ducktown Sulphur, Copper & Iron Co.
Utah Copper Co.
Nevada Consolidated Copper Co.
Chino Copper Co.
Ray Consolidated Copper Co.

The fact that the United Verde Copper Co. is not included in this list is explained by the nature of that company's organization. Its stock is closely held and is one of ex-Senator Clark's valuable properties. The stock is consequently not listed upon any exchange, whereas all the companies listed above, with the possible exception of Phelps Dodge, have numerous shareholders whose interests are always a dominant note in their operations. Copper companies cannot hope to pay dividends when shut down, and if business is on the high road to recovery, as the stock market for one thing seems to indicate, the resuming companies are placing themselves in a position to take advantage of any improvement. The United Verde is in a splendid position to wait until it considers the market price of copper sufficiently high to permit operating at a satisfactory profit.

The sales of copper for the first three months of 1922 totaled about 350,000,000 lb., compared with about 270,000,000 for a similar period in 1921. Last June, July, and August were poor months, and will probably be critical months this year. To show that a great inroad has been made into surplus stocks it is only necessary to consider that foreign and domestic sales of copper for the last twelve months have been about 1,287,000,000 lb., whereas smelter production plus imports have been 700,000,000 lb. All the company reports that have been issued lately indicate large declines in unsold stocks and confirm this position.

Some observers are of the impression that the general reopening of the copper mines will affect prices adversely. Without denying this possibility, there is also, on the other hand, danger of an unexpected shortage of domestic copper as a result of continued curtailment. Resumption may act as a brake to a runaway market and should help to prevent violent fluctuations in price. Should prices remain at a low level there will be some compensation in the knowledge that the reintroduction of copper into abandoned consuming channels will be much easier.

It is noticeable that practically all of the sales of copper that have been made during the last six months have been for future delivery. Selling of copper for delivery even three to six months ahead is at present nothing unusual. This is in decided contrast to the sales in the lead market, which are almost wholly confined to prompt shipments. May not this have something to do with the relative stability of the two markets? Lead is noted for its steadiness; copper for its violent fluctuations.

An interesting development in the foreign copper market occurred recently that has been given scant notice. It was the announcement that the Japanese government has increased the duty on imported copper and brass and bronze. It is now about 2.75c. per lb. The Japanese copper industry has been appealing for protection by its government against cheaply produced American copper for some time. How similar is this argument to that advanced by various interests in Washington! Japan has been a good consumer of American copper, and during the eight months ending Feb. 28, 1922, 70,335,000 lb. of copper was shipped to her. That country is becoming an increasingly important manufacturing competitor, and so should consume larger amounts of the metal. It is one of the ironies of the present world tariff situation that the copper industry, which demands no tariff consideration at Washington, should be the mark of tariff discrimination abroad. Fortunately, exports of copper to Japan are not so important as those to Germany, France, and Great Britain, which remain the bulwarks of foreign commerce in that metal.

Smelter production, exports, and imports are compared in the following table, and indicate little change from the situation of last year. Germany is still the most important customer:

TEN YEAR PRE-WAR EXPORTS AND IMPORTS OF COPPER

Year	Total Exports 000 Omitted	United Kingdom, 000 Omitted	Germany, 000 Omitted	France 000 Omitted	Imports	United States Smelter Production
1904.....	554,550	112,225	103,825	99,888	181,292,200	812,537,300
1905.....	534,900	60,946	104,576	74,604	210,724,700	888,784,300
1906.....	454,752	55,098	96,629	80,703	225,593,300	917,805,682
1907.....	508,930	81,409	107,607	93,075	252,620,100	868,966,500
1908.....	661,876	117,810	137,453	115,690	218,705,500	942,570,700
1909.....	682,847	156,511	138,213	99,003	321,801,110	1,092,951,600
1910.....	708,317	98,030	175,861	116,194	344,435,800	1,080,159,500
1911.....	786,553	108,062	190,428	135,039	334,607,500	1,097,232,700
1912.....	775,000	95,422	252,156	131,363	410,241,300	1,243,268,700
1913.....	926,441	133,680	307,150	160,000	408,700,000	1,224,484,100

POST-WAR EXPORTS AND IMPORTS OF COPPER

1919.....	515,959	105,620	6,831	89,188	302,932,500	1,286,000,000
1920.....	623,613	99,480	89,195	118,489	369,233,600	1,209,000,000
1921.....	626,447	62,335	233,072	8,732	247,673,000	461,000,000
Jan. '22..	54,803	2,757	16,290	7,896	12,880,473	32,010,000
Feb. '22..	50,777	3,799	14,300	10,494	23,163,300	47,418,000

COMPANY REPORTS

Calumet & Hecla Mining Co.

A report of the Calumet & Hecla Mining Co. for 1921 shows a loss of $1,491,259.77, according to the statement:

Copper product for the year (Jan. 1-Mar. 31 only), lb. 15,167,136

PRODUCTION COSTS

		Cents per Lb.	
Mining		9.72	$1,473,607.83
Smelting and refining		2.88	436,937.08
Boston office, mine and corporation taxes		0.87	132,106.04
Depreciation and depletion		5.63	854,385.10
Production cost of	15,167,136 lb. @	19.10	$2,897,036.05
On hand Jan. 1, 1921	47,058,301 lb. @	13.00	6,117,579.13
	62,225,437 lb. @	14.49	$9,014,615.18
Sold in year	38,361,246 lb. @	13.00	4,986,961.98
	23,864,191 lb. @	16.88	$4,027,653.20
Less to reduce to market			686,666.46
On hand Dec. 31, 1921	23,864,191 lb. @	14.00	$3,340,986.74

EARNINGS STATEMENT

Received for copper sold	38,361,246 lb. @ 12.91c. per lb.		$4,951,164.42
Cost of copper sold			
Production cost at 13c. per lb.	$4,986,961.98		
Selling and delivery cost at 0.58c. per lb.	221,934.70 @ 13.58c. per lb.		5,208,896.68
Loss on copper sold		.67c. per lb	$257,732.26
Loss by reduction to market value as above			686,666.46
			$944,398.72
Maintenance costs			
Mine	$869,004.98		
Boston office and taxes	403,439.33		
Depreciation	230,276.94		1,502,721.25
			$2,447,119.97
Miscellaneous credits			
Dividends from other companies	93,151.70		
Interest and silver sales	281,669.91		
Gain from sales of Calumet Transportation Co. stock, C. E. A., Inc., notes, etc.	841,947.71	$1,216,769.32	
Miscellaneous costs			
Examination, depreciation, loss on government copper		260,909.12	955,860.20
Loss for year			$1,491,259.77
Capital assets			
Increased			
New construction	$511,926.64		
Obsolescent	500.00		
	$511,426.64		
Copper Canyon Manufacturing Co. stock	16,387.50		
Copper mines information	113.62		
Stumpage and timber lands	11,231.41		
		$539,159.17	
Decreased			
Calumet Trans. Co. stock	$348,511.00		
Mineral and other lands	15,000.00		
Copper Export Association stock	10,000.00		
Mutual W. L. & P. stock	563.83		
Stamp mill patents	4,922.22	378,997.05	
Net increase in capital assets			$160,162.12
			$1,651,421.89
Increase in reserve for depreciation and depletion		$1,084,662.04	
Less decrease by obsolete construction		170.00	1,084,492.04
Decrease in balance of current assets			$566,929.85
Balance of current assets Dec. 31, 1920			12,901,087.65
Balance of current assets Dec. 31, 1921			$12,334,157.80

Centennial Copper Mining Co.

A report of operations of the Centennial Copper Mining Co. for 1921 states that no copper was produced during the year. Loss for the year was $50,944.75. Balance of current assets Dec. 31, 1920, was $239,703.79; and on Dec. 31, 1921, $193,140.86. Copper on hand Jan. 1, 1922, amounted to 139,802 lb.

Old Dominion Copper Co.

A report of operations of the Old Dominion Copper Co. for 1921 shows a loss of $1,482,055.71, according to the following income amount:

Income		
Sales of copper, silver and gold		$1,987,997.45
Expenses		
Mining, treating and refining	$2,675,914.77	
Selling, general, and administrative	66,165.69	
Expenditure during suspension of operations	372,232.26	
Depreciation of plant	142,527.54	
Depletion of mines	82,661.04	
Interest	130,551.86	
		$3,470,053.16
Loss for the year 1921		$1,482,055.71

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Fixed		
Mines and mining claims	$13,035,503.39	
Plant and equipment	4,149,632.80	
Investments in sundry companies	5,000.00	
		$17,190,136.19
Current		
Materials and supplies on hand	$436,965.48	
Finished metals on hand—copper at cost, silver and gold at market	840,803.12	
Copper sold, Copper Export Association, Inc. (carried at cost, less amount received on account)	396,536.20	
Accounts receivable	145,719.59	
Cash and securities	171,747.01	
		1,991,771.40
		$19,181,907.59

LIABILITIES

Capital stock		
Authorized and issued 350,000 shares of $25 each		$8,750,000.00
Current		
Loans and accounts payable		1,382,402.04
Reserves		
For depletion	$3,878,498.11	
For depreciation	3,596,561.12	
		7,475,059.23
Surplus		
Balance Dec. 31, 1920	$3,056,502.03	
Loss for 1921	1,482,055.71	
		1,574,446.32
		$19,181,907.59

Production amounted to 7,389,648 lb. of copper, 71,155 oz. of silver and 1,186.9 oz. of gold. A total of 14,902,677 lb. of copper was sold at 12.813c. per lb. Operations ceased on April 12, 1921.

United States Smelting, Refining & Mining Co.

A report of operations of the United States Smelting, Refining & Mining Co. for 1921 shows a profit of $1,455,571.98, according to the following consolidated profit-and-loss account:

CONSOLIDATED PROFIT-AND-LOSS ACCOUNT

Earnings of all companies, after charging cost of production, selling expenses, repairs and interest, but before providing for depreciation, depletion and Federal taxes		$2,903,450.72
Deduct		
Reserves for depreciation and depletion	$1,114,430.83	
Federal taxes and additional reserves	333,447.91	1,447,878.74
Profits for year 1921		$1,455,571.98
Undistributed surplus, as per previous balance sheet		$16,781,591.44
Profits for 1921		1,455,571.98
		$18,237,163.42
Less dividends on preferred stock of U. S. S. R. & M. Co. at 7 per cent per annum		1,702,225.00
Undistributed surplus as per balance sheet		$16,534,938.42

The metals and byproducts produced in 1921 from ores extracted at the company's mines in the United States and

in Mexico, and those from custom ores, is given as follows:

		Percentage in Value of Each Product
Copper, lb.	2,195,067	1.3
Lead, lb.	54,721,189	9.8
Zinc, lb.	2,649,875	0.6
Silver, oz.	18,343,722	60.5
Gold, oz.	138,454	13.0
Byproducts, lb.	3,647,084	2.4
Coal, tons	771,100	12.4
		100.0

Current assets on Dec. 31, 1921, were $15,346,681.30, and current liabilities $9,514,679.60. The increase in capital assets amounted to $1,414,227.48.

American Zinc, Lead & Smelting Co.

A report of the operations of the American Zinc, Lead & Smelting Co. for 1921 shows a loss of $260,100.97, according to the following statement:

Losses from operations, being the results of the sales of zinc and lead ores, sales of spelter, pig lead, zinc oxide, limestone and sulphuric acid, receipts from royalties, after deducting all cost of mining, manufacture, marketing ores, spelter, pig lead, zinc oxide, limestone and sulphuric acid, other expenses of operation and all administrative, general and selling expenses and taxes		$188,433.18
Add interest on bonds, less interest on bank deposits		71,667.79
Total loss		$260,100.97
Adjusted surplus at Dec. 31, 1920		2,655,021.09
		$2,394,920.12
Deduct:		
Transferred to depletion and depreciation reserves		379,563.48
Surplus at Dec. 31, 1921		$2,015,356.64

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Property account:		
At Dec. 31, 1920	$12,516,518.19	
Deduct sales, less additions during year 1921	10,562.05	
		$12,505,956.14
Investments		1,472,457.20
Cash in sinking fund for retirement of bonds		2,917.53
Current assets		
Ore stocks	$687,027.17	
Spelter, pig lead, zinc oxide and sulphuric acid stocks	604,905.66	
Inventories of materials and supplies	757,395.91	
Cash	338,059.65	
Notes receivable	69,950.94	
Accounts receivable	445,934.61	
Advance to Wisconsin Zinc Co.	100,000.00	
		3,003,273.94
Deferred charges to operations		84,464.29
		$17,069,069.10

LIABILITIES

	Shares	Par Value	
Capital stock issued			
Preferred stock	96,560	$25.00	$2,414,000.00
Common stock	193,120	25.00	4,828,000.00
			$7,242,000.00
Of which 80,330 shares are in the hands of the public.			
First Mortgage 5 Per Cent, Ten-Year Gold Bonds			
At Dec. 31, 1920		$1,481,700.00	
Less retired through sinking fund		110,800.00	
			1,370,900.00
Reserves for depletion, depreciation, insurance and sundries			5,884,239.18
Current liabilities			556,573.28
Surplus			2,015,356.64
			$17,069,069.10

No record is given of production costs or details of operation of any of the company's units.

Utah Consolidated Mining Co.

A report of operations of Utah Consolidated Mining Co. for 1921 shows a net loss of $338,312, according to the following income account:

EXPENSE

Exploring and development	$111,387.45
Mining, including operating aerial tramway	127,496.88
Smelting	15,533.73
Refining and selling	1,240.33
Administration, including corporation, state and Federal taxes	39,638.85
Legal and professional charges	2,338.40
Litigation expense	30,619.49
Depreciation	12,627.07
Interest	10,250.12
	$351,132.32

INCOME

Sales of metals		$292,759.76
Deduct decrease in metals on hand:		
Inventory at beginning of year	$430,348.29	
Inventory at end of year	139,190.64	292,157.65
		$602.11
Rentals and miscellaneous receipts		12,218.21
Balance, net loss		338,312.00
		$351,132.32

The balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS

Fixed:		
Cost of acquiring properties	$1,649,682.80	
Additions during year	235,386.57	
		$1,885,069.37
Investments:		
8,250 shares of the capital stock of Anaconda Copper Mining Co.	$500,000.00	
U. S. Liberty Loan Bonds — at cost	362,500.00	
		862,500.00
Current:		
Supplies on hand and expenses prepaid	$287,750.31	
Metals on hand	138,190.64	
Accounts receivable and cash	64,598.30	
		$490,539.25
		$3,238,108.62

LIABILITIES

Capital stock:		
Authorized and issued, 300,000 shares of $5 ea.		$1,500,000.00
Reserves:		
For depreciation	$91,826.17	
General reserve	50,000.00	
		141,826.17
Current:		
Accounts and wages payable		671,439.31
Surplus:		
Balance Dec. 31, 1920	$1,263,155.14	
Net loss for the year ending Dec. 31, 1921, per income account annexed	338,312.00	
		924,^43.14
		$3,238,108.62

Production amounted to 299,909 lb. of lead, 41,073 lb. of copper, 4,600 oz. of silver, and 60 oz. of gold. Ore reserves are 837,000 tons of copper ore, averaging 1.07 per cent copper, 0.57 oz. of silver, and 0.04 oz. of gold.

Shattuck Arizona Copper Co.

A report of operations of the Shattuck Arizona Copper Co. for 1921 shows a loss of $33,861.96 as the following account indicates:

INCOME ACCOUNT

Interest	$41,067.18	
Miscellaneous receipts	758.67	
Gross income		$41,825.85
Con. Virginia exploration expense	$21,884.51	
General administrative expense and taxes	25,113.01	46,997.52
Loss		$5,171.67
Reserved for depletion	$12,006.60	
Reserved for depreciation	16,683.69	28,690.29
Net loss, carried to surplus		$33,861.96

SURPLUS ACCOUNT

Balance, Dec. 31, 1920	$318,555.61	
Deduct net loss for year 1921	33,861.96	
Balance, Dec. 31, 1921		$284,693.65

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Mining property	$8,349,015.62	
Less depletion reserve	2,533,648.97	
		$5,815,366.65
Buildings, plant and equipment	$583,824.40	
Less depreciation reserve	377,589.66	206,234.74
		$6,021,601.39
Deferred charges for development		219,987.13
Cash on hand	$133,966.74	
Liberty Loan bonds	826,778.15	
Other securities	8,500.00	
Interest accrued on Liberty Bonds	6,287.06	
Accounts receivable	16,150.54	
Unsold copper on hand at 13c. per lb.	319,212.01	
Ores and concentrates on hand at cost	3,624.38	
Materials and supplies, per inventory	153,280.52	1,467,799.40
		$7,709,387.92

LIABILITIES

Capital stock		$3,500,000.00
Property surplus		3,839,015.62
Accounts payable	$616.86	
Selling expense, not due	15,015.56	
Reserve for taxes	26,017.27	
		41,649.69
Reserve for accidents		44,028.96
Surplus from operations, per annexed statement		284,693.65
		$7,709,387.92

Production amounted to 287,928 lb. of copper, 12,093 oz. of silver, and 28.8 oz. of gold. Operations were stopped on Aug. 1, 1921.

MINING STOCKS

Week Ended April 15, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	62½	62½	62½	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	3⅜	3¼	3⅜	.....	....
Allouez	Boston	27	26	26½	Mar. '19	1.00
Anaconda	New York	53⅜	51⅞	53	Nov. '20, Q	1.00
Arcadian Consol.	Boston	4	2½	3¼	.....	....
Ariz. Com'l.	Boston	9¾	9¼	9¼	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*16	*25	.....	....
Bingham Mines	Boston	15⅜	14	15⅜	Sept. '19, Q	0.25
Calumet & Arizona	Boston	61¼	59½	60¾	Mar. '22, Q	0.50
Calumet & Hecla	Boston	279	274	278	June '20, Q	5.00
Canada Copper	N. Y. Curb	*65	*25	*54	.....	....
Centennial	Boston	11	11	11	Dec. '18, SA	1.00
Cerro de Pasco	New York	37⅜	35⅜	36½	Mar. '21, Q	0.50
Chile Copper	New York	18⅜	17⅜	18⅜	.....	....
Chino	New York	29	27⅛	28¼	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*28½	*28½	*28½	.....	....
Con. Arizona	N. Y. Curb	*4	*3	*4	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	....	....	1¼	.....	....
Copper Range	Boston	45	43½	44	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	1 15/16	1 15/16	.....	....
Davis-Daly	Boston	7⅛	7⅛	7⅛	Mar. '20, Q	0.25
East Butte	Boston	11⅜	11	11⅜	Dec. '19, A	0.50
First National	Boston Curb	*95	*70	*95	Feb. '19, SA	0.15
Franklin	Boston	3	1	3	.....	....
Gadsden Copper	Boston Curb	1½	*60	1¼	.....	....
Granby Consol.	New York	27¼	26⅛	26⅜	May '19, Q	1.25
Greene-Cananea	New York	29⅛	28⅜	29⅛	Nov. '20, Q	0.50
Hancock	Boston	3	3	3	.....	....
Howe Sound	N. Y. Curb	3⅜	3¼	3¼	Jan. '21, Q	0.05
Inspiration Consol.	New York	42	40	41¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†8	†7	7	Sept. '20, K	0.25
Isle Royale	Boston	25	24⅜	24⅜	Sept. '19, SA	0.50
Kennecott	New York	31½	29¼	31½	Dec. '20, Q	0.50
Keweenaw	Boston	3½	1	3⅜	.....	....
Lake Copper	Boston	5¼	3¼	5¼	.....	....
La Salle	Boston	2	2	2	.....	....
Magma Copper	N. Y. Curb	29⅜	28⅜	28½	Jan. '19, Q	0.50
Majestic	Boston Curb	*6	*6	*6	.....	....
Mason Valley	Boston	2	2	2	.....	....
Mass. Consolidated	Boston	4⅜	2½	4½	Nov. '17, Q	1.00
Miami Copper	New York	29⅜	29	29⅜	Feb. '22 Q	0.50
Michigan	Boston	7	2	6⅜	.....	....
Mohawk	Boston	59½	57⅝	58½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8⅜	8	8⅜	.....	....
Nevada Consol.	New York	16⅜	15¼	16⅜	Sept. '20, Q	0.25
New Cornelia	Boston	18	17⅛	18	Feb. '22, K	0.25
North Butte	Boston	13½	12¼	13½	Oct. '18, Q	0.25
North Lake	Boston	*50	*40	*50	.....	....
Ohio Copper	N. Y. Curb	*11	*9	*10	.....	....
Old Dominion	Boston	26	25	26	Dec. '18, Q	1.00
Osceola	Boston	36	25	35½	June '20, Q	0.50
Phelps Dodge	Open Mar.	....	†160	...	Apr. '22, Q	1.00
Quincy	Boston	46½	45	46	Mar. '20, Q	1.00
Ray Consolidated	New York	16	15½	16¼	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*1	*1	*1	.....	....
St. Mary's Min. Ld.	Boston	46	44½	44½	Dec. '21, K	1.00
Seneca Copper	Boston	14¼	14	14	.....	....
Shannon	Boston	1½	*95	1½	Nov. '17, Q	0.25
Shattuck Arizona	New York	9	8⅜	9	Jan. '20, Q	0.25
South Lake	Boston	1	1	1	.....	....
Superior & Boston	Boston	2	1	1⅜	.....	....
Tenn. C. & C. cfs.	New York	12¼	11½	12⅛	May '18, I	1.00
Tuolumne	Boston	*70	*61	*70	May '13,	0.10
United Verde Ex.	Boston Curb	28½	27	28¼	Feb. '22, Q	0.25
Utah Consol.	Boston	2¼	2 1/16	2⅛	Sept. '18,	0.25
Utah Copper	New York	67	65½	66	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1⅜	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	2½	1½	2	.....	....
Winona	Boston	2⅜	*60	2⅛	.....	....
Wolverine	Boston	12⅜	12	12	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	18¼	16⅞	18	Mar. '19,	0.50
Internat. Nickel, pfd	New York	78	78	78	Feb. '22, Q	1.50
LEAD						
National Lead	New York	92⅛	90⅞	91⅛	Mar. '22, Q	1.50
National Lead, pfd.	New York	112	111	111	Mar. '22, Q	1.75
St. Joseph Lead	New York	14⅛	13¾	14⅜	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1½	1½	1½	.....	....
ZINC						
Am. Z. L. & S.	New York	16⅞	16	16⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	42	40	41½	Nov. '20, Q	1.50
Butte C. & Z.	New York	6⅞	6½	6⅞	June '18,	0.50
Butte & Superior	New York	29⅜	26⅛	28½	Sept. '20,	1.25
Callahan Zn-Ld.	New York	7⅛	6½	6⅞	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	145	145	145	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*45	*45	*45	Sept. '20, Q	0.03

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	3/16	1/16	3/16	.....	....
Alaska Juneau	New York	1⅛	1	1⅛	.....	....
Carson Hill	New York	15	14½	15	.....	....
Cresson Consol. G.	N. Y. Curb	2 11/16	2 1/16	2⅛	Apr. '22, Q, X	$0.10
Dome Extension	Toronto	....	....	....	.....	....
Dome Mines	New York	25½	25	25	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*22	*18	*22	.....	....
Golden Cycle	Colo. Springs	*72	*70	*70	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*9	*7	*8	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.65	9.50	9.54	Mar. '22,	0.05
Homestake Mining	New York	75	70	75	Mar '22, M	0.25
Kirkland Lake	Toronto	*47	*44	*45	.....	....
Lake Shore	Toronto	2.39	2.20	2.35	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	19.80	19.00	19.55	Jan. '22, K	0.05
Porcupine Crown	Toronto	*27	*26	*27	July '17,	0.03
Porcupine V. N. T.	Toronto	*31½	*30	*31½	.....	....
Portland	Colo. Springs	*33	*26	*26	Oct. '20, Q	0.01
Schumacher	Toronto	*55	*50	*53	.....	....
Silver Pick	N. Y. Curb	*26	*16	*16	.....	....
Teck Hughes	Toronto	*53	*50½	*52½	.....	....
Tom Reed	Los Angeles	*65	*58	*60	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅞	1 15/16	1 15/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*12	*10	*12	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*5	*4	*5	.....	....
Wright-Hargreaves	Toronto	3.00	2.85	2.85	.....	....
Yukon Gold	N. Y. Curb	1⅛	*95	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1	1⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*38½	*35	*37½	May '20, K	0.03
Coniagas	Toronto	....	....	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*18	*16	*16	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅜	3⅛	3⅜	Apr. '22, Q	0.12½
La Rose	Toronto	*34	*31	*34	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*24	*22	*23½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.03	1.03	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6¼	6¼	Jan. '22, Q, X	0.30
Ontario Silver	New York	7⅛	7⅛	7⅛	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	0.10
Temiskaming	Toronto	*39	*32	*36	Jan. '20, K	0.04
Trethewey	Toronto	*6½	*3	*5½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*25	*21	*22	.....	....
Cash Boy	N. Y. Curb	....	....	*4	.....	....
Dolores Esperanza	N. Y. Curb	2⅛	1⅞	2	.....	....
El Salvador	N. Y. Curb	*4	*4	*4	.....	....
Jim Butler	N. Y. Curb	....	....	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*5	*5	*5	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*74	*67	*72	.....	....
Tonopah Extension	N. Y. Curb	1 1/16	1 1/16	1 1/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅛	1 1/16	1 1/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	1 1/16	1⅛	1⅛	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*5	*5	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*97	*95	*95	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅜	3⅛	3⅜	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	24½	22	24	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†1.85	†1.50	...	July '20, Q	0.10
Daly-West	Boston	2	1⅞	1	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*7	*6	*6	May '20, SA	0.03
Federal M. & S.	New York	....	....	11	Jan. '09,	1.50
Federal M. & S. pfd.	New York	40	39½	39½	Mar. '22, Q	1.00
Florence Silver	Spokane	*25	*25	*25	Apr. '19,	0.01½
Grand Central	Salt Lake	*57	*56	*57	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5⅜	5⅛	5⅛	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*21	*21	*21	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†2.40	†2.00	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*7	*7	*7	June '21, I	0.02
Prince Consol.	Salt Lake	*8½	*3½	*3½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*4	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*10	*8	*8	.....	....
South Hecla	Salt Lake	†*60	†*35	...	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*17	*17	*17	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*18	*11	*18	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.25	2.25	2.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.92½	1.85	1.85	Dec. '21, Q	0.05
Utah Apex	Boston	3½	3 1/16	3⅜	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	44⅞	42	44	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	63	59	62	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	....	....	77½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	18⅜	16½	18	Nov. '19, Q	1.00
Texas Gulf	New York	43⅜	40⅜	43	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	59⅜	56½	58⅞	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	98¼	97⅛	97⅛	Mar.'22 Q	1.75
Am. Sm. Sec. pf. A.	New York	95	91½	92	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	39	38	38	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	46½	46	46	Apr. '22, Q	1.75

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

NEW MACHINERY AND INVENTIONS

A New Type Jaw-Crusher Frame

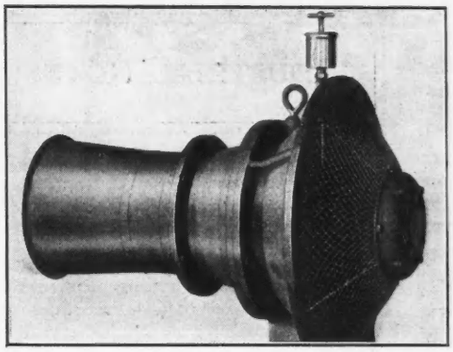
The use of Blake-type jaw crushers of increasingly large sizes has led to the design of these machines with sectional frames. The reasons are that the single piece frame is unwieldy and also because of the difficulty of making such a frame that would withstand the great crushing strains developed in the breaking of large pieces of hard rock. The rigidity of a single-piece casting, particularly at the corners, has always been a source of trouble, excessive strains resulting in a breaking away at one of these points.

In an effort to obviate both of these difficulties the sectional or four-piece frame was developed. Ordinarily, the four-piece frame is designed so that the side frames are grooved and the end frames mortised into them. Bolts through the end frames and secured outside the side frames hold the parts together. It is difficult to say definitely which of these alternatives, so far as breakage is concerned, is worse. The solid frame is absolutely rigid, and the mortised construction provides a sharp corner in which the slightest flexure of the end frame develops a crack which soon results in a breakage of the side frame. To further promote this sort of breakage, the ordinary crushing strains are not distributed along the central axial plane of the side frames, but are to one side, or overbalanced. This breakage is not unusual.

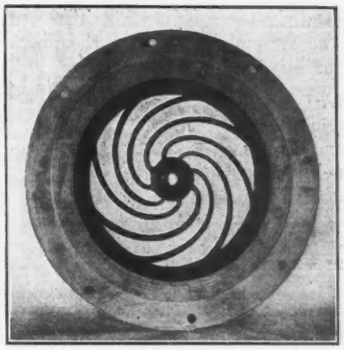
Recognizing the basic error of existing designs of this kind, the engineers of the Kennedy-Van Saun Manufacturing & Engineering Corporation have sought the development of a new type of crusher frames that would obviate this corner weakness and make a strong point out of what has always been a particularly weak one. The result is the Kennedy hinge-joint frame. In this machine the extremities of the side and end frames are made circular in section, the end frames fitting into the side frames, the whole joined by a heavy steel pin. In this design the crushing strains are balanced through the side frames, taking advantage of all the strength of the metal. Being made of box section steel castings, they will resist any strain placed upon them in normal crushing operations. There are no corners or edges, and any slight flexure of the end frames under heavy crushing has no effect whatever on the side frames, as the pin allows enough freedom to relieve any such movement without transmitting it to the side frames.

Rigidity of the essential parts of the frame, to maintain shaft alignment throughout, is insured by three precautions: First, the front end frame is inclined and the rear end frame is vertical; second, heavy through bolts with spacers join the side frames between the swing jaw and pitman; third, the rear end frame is made with a heavy rib projecting inwardly and securely bolted at its extremities to the side frames. There is no possibility of the machine getting out of alignment. The inclination of the front end frame, about the same as the swing jaw, also insures half of the weight of the stone being carried on the frame, increasing the sliding moment with less power. This equalizing of the slope also has the advantage of allowing the machine to handle effectively a larger piece than would be possible in crushers of the same size that have one of the two jaws vertical.

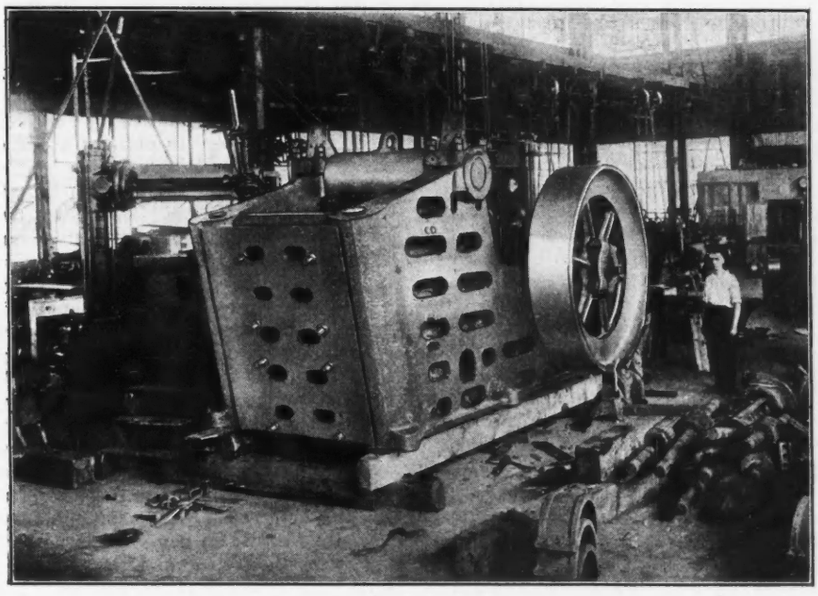
The remaining parts of the machine are made in the same way that has been typical of Kennedy crushers and all features that go to make a successful Blake-type crusher are incorporated.



The Coppus "Vano" blower



Stationary guide vane of blower



Jaw crusher with hinge joint frame

A Propeller Blower of Wide Application

The field of usefulness for propeller blowers has been limited. With the exception of low-duty ventilating fans, propeller blowers have been employed almost exclusively for under-grate draft on hand-fired boilers or with chain grate and over-feed stokers, on account of their low efficiency at higher pressures. However, with the inclusion of certain features propeller blowers may be adapted to many uses, such as under-grate or forced draft for hand-fired boilers, chain grate, over-feed and under-feed stokers; induced draft; ventilation for mines; air heating and drying installations; cooling of electric motors and generators, and ventilation of factories, boiler rooms, ships, and tunnels.

A new type of blower, which has a screw-blade propeller, has been developed by the Coppus Engineering & Equipment Co., of Worcester, Mass. This blower, known as the "Vano," delivers the air parallel to the axis; or, in other words, the air leaves in the same direction as it enters. The blowers differ from other propeller types in the following points: They operate against pressures up to 8-in. water, and therefore can be employed where, until now, only centrifugal blowers could be used; their efficiency runs up to 80 per cent, and the power consumption at constant speed is practically unaffected by variations in air delivery or pressure.

The principal feature of the "Vano" blower is the stationary guide vane of

peculiar design beyond the propeller. The air current leaving the propeller is radially subdivided by the individual guide vane blades and taken up by them without shock. The guide vane blades, which have a curvature, increasing in the direction of the rotation of the propeller, concentrate the air current and give it a further acceleration inside of the stationary guide vane so that a considerable part of the pressure is produced in the latter. A large part of the end thrust is thus taken up by the stationary guide vane casing. The air streams, into which the flow of air has been subdivided by the guide vane blades, leave the guide vane casing, on account of the kinetic energy, slightly rotating and convergent toward the axis, so that the smallest section of the air flow is reached beyond the guide vane casing.

It is claimed that these blowers have an efficiency as high as 80 per cent for both high and low pressures, so that the power consumption is much smaller than that of any other type of blower of the same capacity and pressure.

Vano blowers are high-speed machines, and as a result of the compactness of design, the blowers can readily be installed in pipe lines, which is a distinct advantage in ventilating, heating, and drying systems. They work with the same effect and efficiency when installed at the entrance or at the end of the air duct, operating as blowers or exhausters, respectively.

To deliver air through long pipe lines, high initial pressure is necessary. As it is impossible in mine practice to keep air ducts tight, especially at the joints, the losses on account of leakage, which, of course, increase with higher pressures, are often many times the actual air delivery at the discharge of the pipe. Instead of using a centrifugal blower delivering a certain capacity at, for instance, 12-in. pressure, three Coppus Vano blowers delivering the same amount of air at 4-in. pressure can be installed in series equidistant apart in the pipe line or air duct. The losses through leakage are thus reduced to a fraction of the losses at high pressure.

The blowers allow the reversing of the direction of rotation, which changes the direction of the flow of air through the blower. Thus operated they deliver from one-third to one-half of their normal capacity.

A remarkable feature which is claimed by the manufacturers is the constant power consumption at a constant speed, practically unaffected by air delivery and pressure. The power consumption of a propeller blower increases materially with increase in pressure, whereas with centrifugal blowers the horsepower curve rises rapidly with decreasing resistance. As in few installations the required pressure is known exactly beforehand, it is necessary with electrically driven machines to select motors with ample reserve capacity to prevent overloading and subsequent burning of windings.

INDUSTRIAL NOTES

The General Chemical Co. announces that the New York offices have been moved from 25 Broad St. to 40 Rector St., New York City.

On and after March 30, 1922, the principal office of the Uehling Instrument Co., manufacturers of CO_2 recorders and other fuel-economy equipment, will be at the company's factory, 473 Getty Ave., Paterson, N. J., instead of at 71 Broadway, New York City.

The General Engineering Co. of Salt Lake City and 120 Broadway, New York, have been appointed metallurgical engineers for the Annapolis Lead Co., St. Louis, Mo., in the design and construction of a 500-ton concentrating plant at Annapolis, Mo. The work will be under the personal charge of C. E. Chaffin, eastern manager of the General Engineering Co.

The Lytle Coal Co. recently ordered two additional 7-ft. diameter Hardinge conical mills to complete their grinding plant at the colliery at Minersville, Pa. Experimentation has shown that the power required for grinding three tons per hour of anthracite coal to a fineness of 92 per cent through 200 mesh is only 22.3 hp. hours per ton. For the mill and air separation equipment it required only a total of 72.5 kw., or 24.2 kw.-hr., per ton; steel consumption amounted to about 5c. per ton, and replacements are made without shutting down the mill or one minute lost time, merely by feeding balls into the discharge end of the mill as the operation continues.

Increased activity is indicated in recent sales of electric-furnace equipment, according to the Electric Furnace Co., Salem, Ohio. A large manufacturer of manganese steel castings for railroad purposes has just placed an order for a 250-kw. car type Baily annealing furnace for one of its plants on the Pacific Coast. This equipment will have a capacity to heat seventeen tons of manganese steel per day. Another recent order calls for a 125-kw. melting furnace for ferromanganese. This furnace is to be installed at the plant of the Pettibone-Mulliken Corporation, Chicago, and will be used for making hot additions to each charge from their Herroult electric steel furnaces. The Baily unit will have a capacity of 1,000 lb. of ferromanganese per hour. The Griffen Wheel Corporation has ordered a 75-kw. melting furnace for melting bronze for railway bearings. This furnace will have a hearth capacity of 1,000 lb., and will be installed at Tacoma, Wash. The Best Foundry Co., Bedford, Ohio, a subsidiary of the American Stove Corporation, has contracted for a 50-kw., 500-lb. melting furnace for melting its copper-zinc alloys.

TRADE CATALOGS

Iron Ores—Clement K. Quinn & Co., Duluth, Minn., and Cleveland, Ohio, have just issued their 1922 "Season Analysis" book, which contains the names and range of analyses of the various grades of iron and manganiferous iron ores mined and sold by the company.

Cyanide Equipment—Full descriptions of Merco precipitation processes and products are given in an attractive new catalogue of eighty-three pages recently issued by the Merrill Company, of San Francisco. The subjects include The Merrill Precipitation Process, the Crowe Vacuum-Zinc Shavings Process, the Merrill Sluicing Clarifying Filter, the Merco-Nordstrom Plug Valve, and Merrillite. The information given will prove highly interesting to all gold and silver metallurgists, for it is attractively presented and authoritative. The Crowe Process, described in this book, is possibly the latest great advance in precipitation practice, and has been approved by metallurgists throughout the world.

Flotation Oils—The Hercules Powder Co., has recently issued a pamphlet giving complete specifications of the various flotations oils now marketed by that firm. These include: Yarmor, a steam-distilled pine oil; Remoh, similar to but not so highly refined as Yarmor; Floto, similar to Remoh but of lower grade; Century, a specially made pine product; Risor, the crudest steam-distilled pine oil manufactured; and Tarol, a crude reagent. Directions are also given for testing flotation oils and detecting adulteration. Another brochure by H. J. Stander, "Flotation," gives a brief survey of the subject and mentions the method of manufacture of steam-distilled pine oils. Both booklets may be obtained without cost on application to the Hercules Powder Co., Naval Stores Division, Wilmington, Del.

Fireless Steam Locomotives — The fireless steam locomotive is without boiler and firebox. In place of a boiler, it carries a tank containing water which is heated by steam from a suitable stationary boiler. To insure dry steam the storage tank is only four-fifths filled with water. The locomotive tank is specially lagged and jacketed to prevent loss of heat. As steam is used by the locomotive the temperature of the water and the pressure of the steam in the tank are gradually reduced and part of the water turns into steam. Fireless steam locomotives are not new and are not offered as a universal substitute for steam locomotives of usual construction. The H. K. Porter Co., Pittsburgh, Pa., has issued a thirty-two page catalog which describes the types and uses of this kind of locomotive. It is entitled "The Porter Fireless Steam Locomotive."